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Testing Glass for Strength

By G. M. BARTENEY and A. I. IVANOVA

Translated by CHARLES H. GREENE, Chairman, Department of Glass Technology, College of Ceramics, and CHARLES D. BUCHANAN, State University of New York, Alfred University, Alfred, N.Y.

• A LARGE AMOUNT OF WORK has been devoted to the study of the influence of various factors on the strength of glass; but nevertheless, the strength of industrial glasses up to the present time has been studied inadequately because the majority of investigations were carried out on compositions of glass essentially differing from those which industry manufactures. In addition to this, understanding of the individual factors is not always possible owing to the absence of definite methods for determination of the mechanical properties of glass.

In the majority of cases, excluding glass fibers, when glass is loaded, it is under bending stress. For this reason, for specification of the fundamental strength of glass, breaking tension under bending deformation has been taken, i.e. modulus of rupture.

In our experiments tests of samples of glass were carried out for strength by bending with glasses of two types—vertically drawn and continuously rolled. The approximate time of breaking was established as one minute.

First of all it seemed interesting to establish the influence of the shape of the supporting knife edges on the significance of the strength of glass obtained in the testing of samples. This work was carried out on the breaking machine with a varying arrangement of two types of supporting and bending knife edges: cylindrical, with a radius of 5 mm., and triangular, with sharp corners and 8 mm. sides. For the testing samples of glass were used from vertical drawing of a size 100 x 26 x 6 mm. Blocks of samples were subjected to a light polishing. In each lot twenty-five samples were tested.

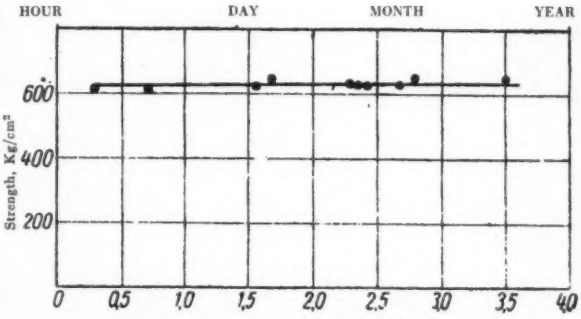

Fig. 1. Log time of keeping in hours.

The results of testing, represented in Table I, show that the form of the supporting knife edges does not show an appreciable influence on the significance of the strength of glass.

The influence of the time the samples were kept was determined on samples of vertically-drawn glass of a size 150 x 30 x 5.5 mm. The edges of the samples after cutting were not subjected to any additional reworking. The surface on which the diamond scratches were made was under extension in the experiment.

All the samples were cut at one time and were broken into lots of 15 each. The tests were carried out over the course of 5 months. Results are illustrated in Fig. 1.

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Table I

Form of supporting knife edges and group of samples	Strength in bending	Average arithmetical error in a given group
	Kg/cm²	Per cent
Cylindrical		
First Group	665	11.0
Second Group	635	8.5
Triangular		
Third Group	640	10.0
Fourth Group	615	10.0

In the figure it is seen the strength of the glass did not change with the time of storage. Consequently, insignificant changes of temperature and humidity of the surrounding medium, which are inevitable in the carrying out of protracted investigations, do not show a noticeable influence on the results of the tests.

With the bending under the influence of a load, maximum stresses come to the surface of the plate opposite to the point of application of the load. The maximum stress changes according to the length of the sample tested. Insofar as the maximum stress is recorded at the midpoint of the lower surface, breakage is to be expected just at this place. Actually, as observations have shown, failure does not always begin at the place of action of maximum stresses coming from the load. This again confirms the fact that the strength is determined by flaws in the samples and that its magnitude is greater at some points than at others. Some earlier investigators have called attention to this phenomenon; however, it has not been evaluated quantitatively.

The strength of glass in bending is ordinarily calculated by the formula:

$$P = \frac{3\ Q1}{2\ bd^2}$$

where Q = Weight on the sample bringing about the breakage in kg;
l = Distance between supports cm;
b = Width of the sample cm;
d = Thickness of the sample cm.

As was shown above, breaking does not always occur at the point of action of maximum stress 1/2; hence, it would be more correct to calculate the strength by the formula:

$$P = \frac{3\ Qc}{bd^2}$$

where c is the distance from the spot of failure to the nearest support. In an ideal case c ought to be equal to 1/2.

In the determination of the strength of glass, the place of breakage of the sample was fixed. The value of c was calculated as the mean arithmetical value for a group. In each group fifty samples were investigated. The results of the investigation are presented in Table II.

Table II

Number of the group.	½ mm	c mm	P > P¹ per cent
1	75	69	9
2	60	54	11
3	50	48	5
4	38	33	15
5	25	22	13

An analysis of the data presented in Table II shows that the values of the strength calculated by formula (1) are higher in comparison with the stresses actually causing the breakage by approximately 10 per cent.

In order to determine the strength of the material correctly, it is necessary to gauge the character and magnitude of the forces accurately and after that, to employ a formula suitable to the given case in accordance with the forces acting upon the sample being investigated.

We, like other investigators employed formula (1) in the calculation of the strength of glass in bending. It was necessary to choose the sizes of samples of glass whose strength could be calculated by this formula.

The simplest formula for the calculation of stresses in bending shows that bending stresses in the beam are proportional to the distance from the neutral axis. This conclusion is correct as long as it is a question of beams, the transverse section of which is small in comparison with the length, and as long as the points ex-

Table III

Group No.	No. Samples in Group	Degree of Strain	Surface Area of Sample	Average Strength	Average dimensions of sample			Average Arith. Error
					length	breadth	thickness	
		M/cm	cm²	Kg/cm²	mm	mm	mm	per cent
1	15	2,16	151	1890	150	100,5	6,71	7
2	14	2,2	84,5	1790	84,5	100,0	6,67	13
3	16	2,12	40,0	1860	84,5	47,2	6,68	10
4	14	2,17	40,0	1720	90,0	44,5	6,38	7
5	15	2,12	42,0	1740	90,0	46,5	6,68	12
6	15	0,12	145,0	430	150,0	97,0	6,63	14
7	16	0,12	85,0	525	84,5	101,5	6,63	25
8	14	0,12	39,0	540	84,5	45,8	6,67	13
9	15	0,12	23,2	585	50,0	46,4	6,66	11
10	30	0,1	17,5	620	100	17,5	5,8	10
11	20	0,1	30,5	645	100	30,5	5,76	8
12	20	0,1	37,0	650	100	37,0	5,82	7
13	19	0,1	49,0	645	100	49,0	5,78	9,5
14	20	0,1	115,0	635	180	63,0	5,79	9
15	18	0,1	111,0	620	180	61,5	5,84	10

amined are located at an appreciable distance from the ends.

Formula (1) is applied also for the calculation of the strength in bending of thin plates. When, as B. G. Galerkin, Akad. showed, the distance between the supports exceeds more than ten times the thickness of the plate, but only when the bending in this instance does not exceed half the thickness.

We carried out experiments on the correlation of length and breadth of sample with the value of the strength. Data from these investigations are shown in Fig. 2.

As we see, for a change of the ratio 1/b from 1 to 6, the value of the strength of the glass calculated by formula (1) does not actually change.

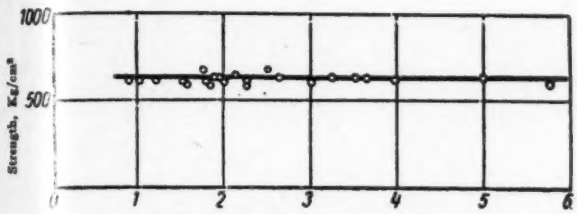

Fig. 2. Ratio of length to breadth 1/b.

According to investigations published in the literature, the value of strength, to a large degree, depends upon the size of the samples tested. These investigations embrace a range of areas of samples from 1 to 10 cm^2 and larger up to 200 cm^2. Our investigations were carried out on samples with a size from 15 to 150 cm^2. The results of the investigation are presented in Table III.

The data obtained bears witness to the fact that the value of strength, not only of annealed but of tempered glass with a sample area within the limits of 15 and 150 cm^2, does not depend significantly on their size.

All investigators note that the values of strength obtained increase with decrease in thickness of the sample.

The dependence of strength upon thickness of glass has been much less studied for glasses with thicknesses between 4 and 16 mm. In the literature, as a rule, it is not indicated by what means the glass has been prepared and whether the means of preparation and working of the samples were one and the same for all the thicknesses tested.

Table IV

Method of Manufacture of Glass	Thickness mm.	Strength Kg/cm²
Continuous Rolling	7,3	605
	6,93	590
	4,60	595
	2,50	695
	2,15	740
Vertical Drawing	5,03	680
	4,12	700
	3,32	670
	3,16	760
	3,20	780
	2,25	890
	1,96	850
	1,76	965

The results of the experiments for determination of the influence of the thickness of the sample upon the value of the strength of vertically-drawn glass are illustrated in the curve in Fig. 3; for comparison, data of other investigations is plotted on the graph.

1) Glass of the Constantine factory.
2) Gusevski factory.
3) Gorkivski factory.
4) Luberetski factory.
5) Data of Graf Glastechn. Ber. *13* 232 (1936).
6) Data of Petrov.
7) Data of Tyremnova and Lioznyanski.

From the graph in Fig. 3 it is evident that with a decrease in thickness of the glass in the interval from 16 to 3 mm. the value of strength increases from 550 to 750 Kg/cm^2; but with further decrease in thickness of the samples it begins to rise sharply. Analogous results were obtained in testing samples of glass with ground and polished surfaces. The kind of dependence established by us agrees with the data of the literature.

It was of special interest to determine the strength of samples of varying thicknesses which had been ground

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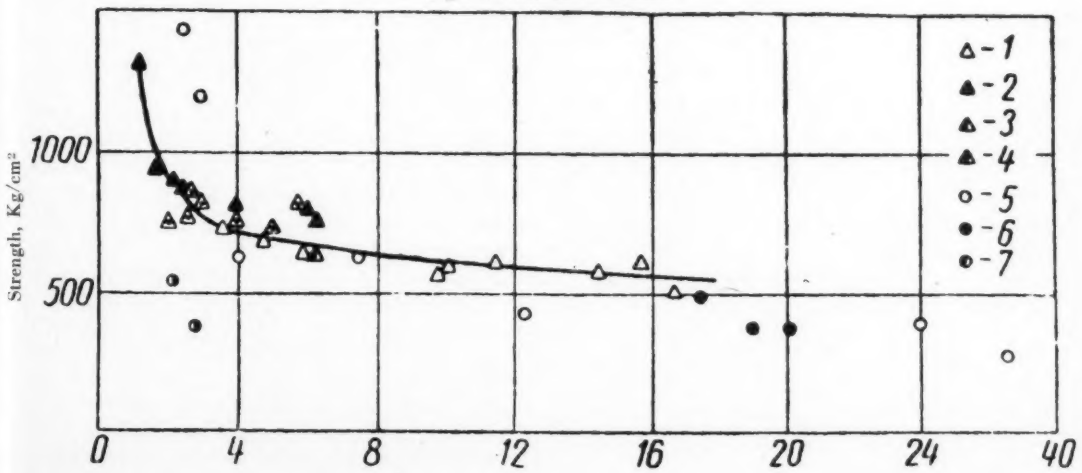
Fig. 3. Thickness d mm.



Radiant Gas Heat in Glass Bending Operations

By HAROLD A. McMASTER, President,
Permaglass, Inc., Woodville, Ohio

• THE USE OF Selas gas-fired Duradiant burners in the glass-bending furnaces at the Genoa, Ohio, plant of Permaglass, Inc. has provided the accuracy of control and fast response so critical to the successful production of crowned and special glass forms.

This plant, one of two Permaglass plants in Ohio, concentrates its entire resources on the bending of glass pieces in their final stage of production. At present, the plant's major product is television glass, (Fig. 1) the production of which it pioneered. Other finished products the company is turning out include small glass forms for gasoline pumps, radar shields, highway markers, motion picture reflectors and larger pieces, such as automobile rear windows and motorboat windshields.

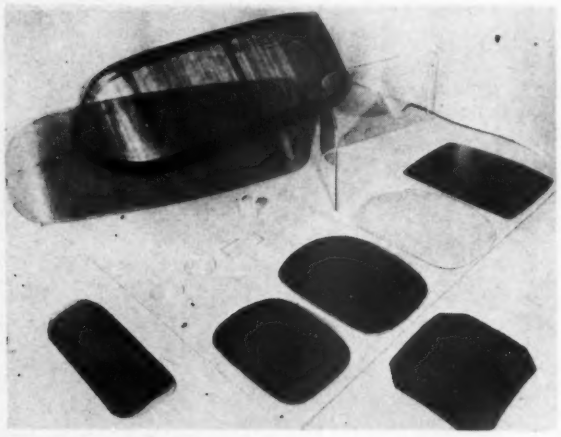


Fig. 1. Glasses bent to different contours: foreground, television screens; center, glasses for meters and other small units; background, rear automobile window. Television screens are company's major product.

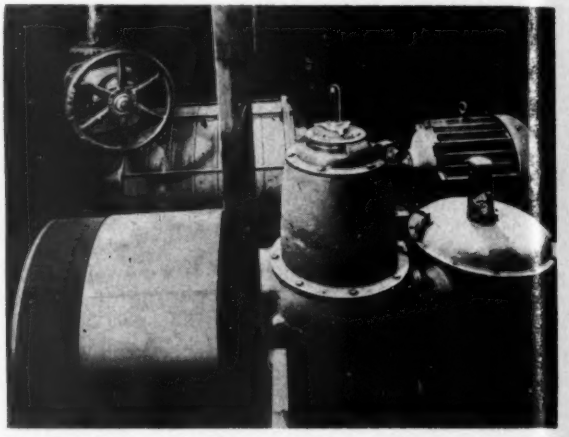


Fig. 3. Selas combustion controller equipment, in shed outside plant proper, mixes gas and air in correct proportions, compressing and delivering mixture to a main which supplies burners in both furnaces.

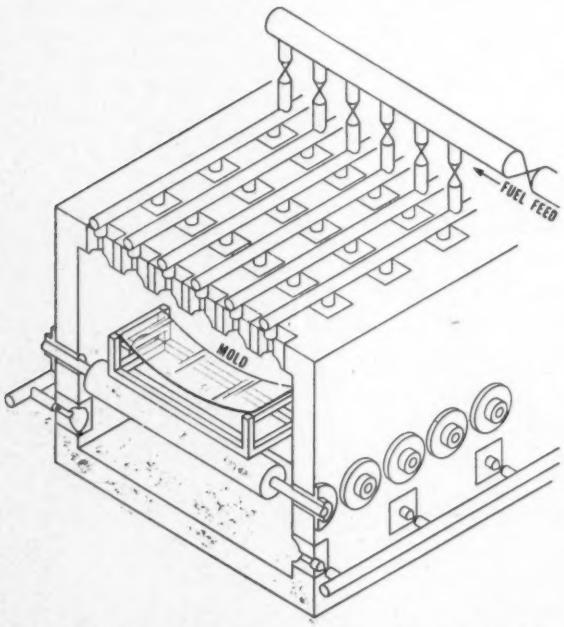


Fig. 2. Sketch showing approximate location of Duradiant burners in typical section of one heating zone of tunnel furnace. Burners are flush with roof or walls.

Originally, heating for bending operations at the plant was done with electric resistance-type radiant heaters, which were expensive both in cost and upkeep. Their large mass retained heat to such an extent that response to desired variations in heat input was sluggish and time-consuming.

It was also difficult and, at times, impossible to provide the desired heating patterns, a factor which resulted in improperly bent glass shapes.

Gas-Fired Radiant Heating

To achieve required heating patterns in less time and at less cost, the company converted both furnaces at this plant to gas-fired radiant heating. The conversion involved installation of several radiant burners (Fig. 2) in the roof of each furnace, and additional burners in the side of one furnace about half-way between work surface and hearth.

Designed and built by Selas Corporation of America, Dresher, Pa., this Gradiation heating system permits the precise patterning of heat so vital to accurate glass bend-

ing, and provides the quick response to control so necessary for adjusting patterns to meet new temperature requirements.

The burners in both furnaces operate on a precise ratio of gas and air, which is mixed and compressed in a Selas Combustion Controller (Fig. 3) located in a shed outside the plant proper. The mixture is then fed by overhead mains to the furnaces. Constant air-gas ratios and mixture delivery pressures are maintained, regardless of the number of burners cut in and out, variations in fuel demand, barometric pressure changes, or gas-line pressure fluctuations.

By burning these closely-controlled gas-air mixtures against the burner cup-shaped refractory surfaces, the surfaces become incandescent and beam radiant heat to the work at the speed of light.

The overall speed in heating the work is accomplished by a combination of this high rate of heat transfer, the high temperature gradient attained, and closeness of the

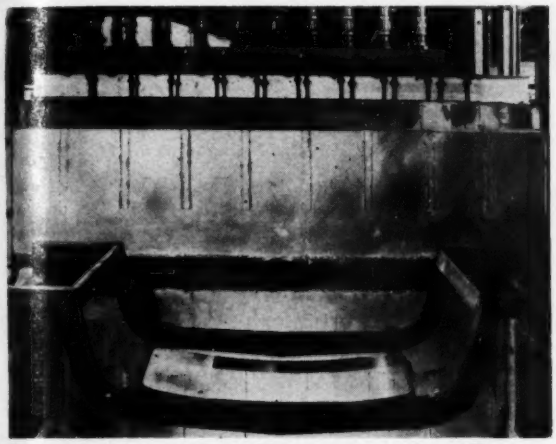


Fig. 4. Stainless steel mold, at center of cradle, supports flat glass blank to be bent to mold's contour in heating zone. Ten risers above furnace feed ten headers, each of which supplies six burners in furnace roof.

work surface to the heat source. Such proximity is safe because the burners have no harmful flame impingement, combustion being completed entirely within the cup.

Since the heat from Selas radiant burners can be directed to cover specific areas in varying intensity, the patterned heating so important in Permaglass bending operations is now being very successfully applied, and at far less cost than with the former method.

Perfect maintenance of prescribed temperatures is also being assured in all areas, including those usually subject to drafts and high edge heat losses.

All Glass Bent by Action of Gravity

An interesting example of how Permaglass now keeps its patterned heating closely controlled for glass bending is well demonstrated in its forming of television glass by action of gravity.

A continuous indexing tunnel type furnace with six heating zones is being used for forming television glass. Four of the six zones employ twelve burners each, eight strategically located in the radiant roof and two in each side wall about half-way between work level and hearth.

Fig. 5. Panel of instruments which indicate and control temperature in each of three pairs of heating zones of continuous indexing furnace.

When the mold carrying the glass (Fig. 4) enters the last two zones, which have thirteen burners each, the right amount of heat, regulated by instruments (Fig. 5), is directed to the center of the glass, where no support has been provided, and the glass sags into the exact "dished" or "crowned" shape desired.

The forming of rear glass for automobiles, motor boat windshields and other relatively large parts is processed in the other Duradiant heated furnace (Fig. 6). The same "heat sag" methods are employed, although this furnace has only one heating zone. All burners are installed in the roof and all primary heat is radiated down. As considerable heat passes through the glass, the hearth and mold, as

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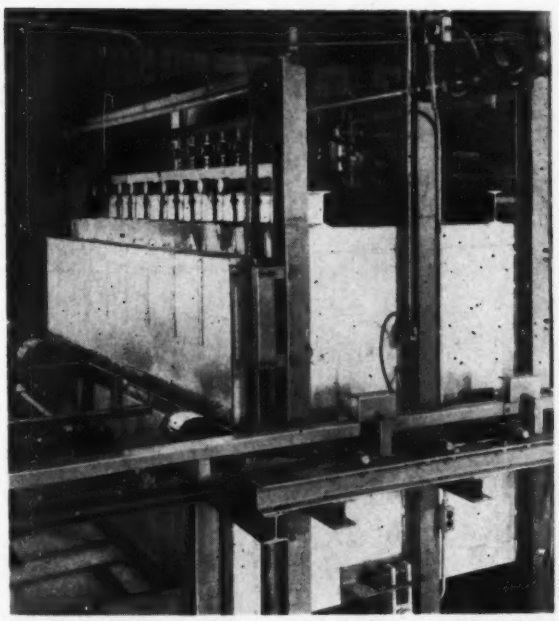

Fig. 6. Automotive furnace. Vertically movable doors open simultaneously to admit, from left, carriage holding a mold indexed along a track and supporting a flat glass, and discharge, at right.

Ancient and Modern Diatreta

By ALBERT CHRISTIAN REVI, Dallas, Texas

Fig. 1 (left). Trier Diatreta, Landesmuseum, Trier, Germany. Fig. 2 (right). "Situla," Treasury of St. Mark's, Venice, Italy.

Fig. 3. Collection of Wurttembergische Metallwarenfabrik in Geislingen, Steige, Germany. Made by Karl Weidmann.

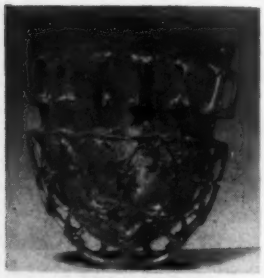

Fig. 4 (left). Diatreta Vase. Antiquarium, Munich, Germany. Fig. 5 (right). Diatreta Vase. Lent by Frederick Carder, National Collection of Fine Arts, Smithsonian Institution, Washington, D.C.

• DIATRETA VASES or "cage cups", as they are sometimes called, represent a group of Roman glasses which are covered with a network of thin glass supported by small glass struts. The few pieces known to us date from about the third or fourth century A.D. That part of the world in which most pieces have been found is known as the Roman-Germanic Cologne area. The latest find occurred at Niederemmel, in 1950, and is now housed in the Landesmuseum, Trier, Germany.

At first examination these glasses seem to be essentially of the same kind, but there are variations which make it possible to classify them in three distinct groups.

a. Diatreta which are completely covered by a network of glass. (Fig. 1)
b. Diatreta with letters on the upper portion and ornamental network on the lower portion. (Fig. 4.)
c. Diatreta with ornamental figure reliefs and a network of glass. (Fig. 2)

While the ancient diatreta vases may differ in coloring they have certain characteristics which can be found in all vases.

1. The basic form is that of a bell.
2. The network is opened at the base.
3. There is a pad-like swelling at the rim of the vase.
4. There are rosette ornaments at those points where the struts join the outer network with the body of the vase.

These four characteristics formed the basis for conclusions reached by several glass technologists and antiquarians. The famous 18th century German archeologist, art historian and antiquarian, Johann Joachim Winckelmann (1717-1768), discussed the diatreta technique in his "Annotations on the History of the Arts among the Ancients" suggesting that the cage cups were actually cut from a thick bodied beaker (Fig. 6). This praxis was championed by F. Fremersdorf in his article "Die Herstellung der Diatreta," published in Mainz in 1930. H. Eiden, the curator of the lately found Trier Diatreta, agrees.

Practically speaking, it is difficult to reconcile oneself with Herr Fremersdorf since this theory presupposes that the ancients had access to drills and engraving tools similar to those used in modern dentistry. (Fig. 6, right). We are inclined to discount this, since we have no corroborating evidence to prove these implements existed at such an early date.

Furthermore, it is unlikely that the ancients would choose so difficult a form as the bellshape to cut with their straight wheels. The traces of cutting found under the net and on the body of the ancient specimens referred to by Fremersdorf, in supporting his theory, would appear to be nothing more than attempts at correcting the fit of the two casings. Very few traces of

grinding are evident on the outer wall of the inner body, and none are on the back of the network attached thereto.

Unless we are willing to agree that the ancients were capable of polishing these seemingly inaccessible areas we are forced to conclude that the diatretum was formed by two cup-like bodies joined together with small glass struts, instead of being cut from a thick-walled beaker.

Carl Friedrich published some papers on the diatreta theory in the magazine "Sprechsaal" (1881 and 1882). Besides his own praxis, which incidentally coincides somewhat with the Winckelmann-Fremersdorf observations, he advanced an idea sponsored by H. W. Schulz and de Rossi, who explained the manufacture of cage cups by stating that the body and net were made separately and afterwards fused together. This opinion is not shared by other glass technologists.

Reviewing the book, "La Verrerie Antique" by W. Froehner (1879) in the "Bohner Almanach" (1882), Carl Friedrich wrote, "It seems to be difficult indeed to convince a non-expert eye of the application of a production technique, whereas all experts who have the opportunity to see a diatretum immediately agree on the production technique. Producers, makers, and grinders of glass who saw the diatretum at the Antiquarium in Munich were convinced at first sight that it had been manufactured by the use of the grinding wheel. The work is said to be too time-consuming and impossible!

"I have published a few articles about the diatreta in 'Sprechsaal' (1881, No. 1-4). These articles came to the eyes of a manager of a glass factory located in the Bavarian forest. Challenged by the fact that the ancients were credited with more achievements in some technique than we ourselves, he went to Munich in order to inspect the diatretum concerned. He then immediately initiated the undercutting and grinding through of pieces of glass in his factory.

"Thus, within the shortest time some brilliantly achieved pieces, completely undercut and ground through, were completed which are in no way inferior to the ancient Roman achievements. One such piece, a beer-stein cover, could be seen at the Bavarian Exhibition of Industry, Trade and Art in Nuremberg where everybody could admire it as a masterly achievement. The factory concerned plans to produce an accurate copy of an old Roman diatretum in the near future and believes to be able to do this for a few hundred marks since it requires hardly half a year to produce it. Therefore, away with the talk that it takes a whole lifetime to produce a diatretum.

"Since so far all the experts agreed on the manufacture of the diatreta, this latest achievement is hoped to also dissuade scientists like Herr Froehner from their doubts. More details about the glass involved were reported by me in the "Ausstellungszeitung der Bayrischen Landesausstellung No. 71 and in 'Sprechsaal' 1882, No. 27."

The man who undertook the cutting of the pieces mentioned by Friedrich was Anton Roeck of the Ludwig Stangel Fabrik, Spiegelau.

In 1932 O. Knapp proposed a theory which was later put to the test by W. von Eiff, a prominent glass engraver

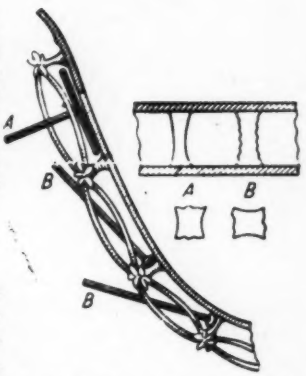

Fig. 6. Sketch (above) from F. Fremersdorf's article, "Die Her-Stellung der diatreta." Aus: Schumacher-Festschrift, Mainz, 1930, pages 295-300. (Right) Sketch of Proposed method of engraving details of the diatreta as taken from Glastechnische Berichte No. 27, 1954.

of our day. Knapp suggested that diatreta were made by first forming the inner body of the cup, attaching rings of glass at equidistant points about this body, and then placing the inner body in a cup of glass made to receive it. After proper annealing the blank was cut through (Fig. 7).

While this method approaches a more practical view of the manufacturing technique necessary to produce a diatreta vase it was nevertheless reported a failure by Karl Weidmann, the man who collaborated with von Eiff in these experiments.

In his report to the Glastechnischen Geselschaft (Frankfurt-am-Main, 1953) Karl Weidmann casts some doubt that a "real diatreta" was ever made by Anton Roeck and further stated that he believed these attempts were limited to a revival of the ancient cutting technique, rather than to the making of a real diatretum. This writer has been unable to find any visible evidence of the wares made at Spiegelau, though certainly, at least a stein cover was produced.

Having worked closely with von Eiff for some time during his diatreta experiments, and finding these at-

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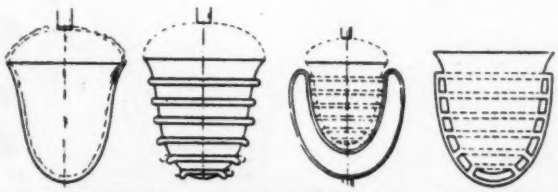

Fig. 7. Sketch from O. Knapp's "Diatreta und ihre Herstellung," Keram. Rdsch. 40, 1932. Pages 116-117. Refer also to Glastechn. Berlin, 11 (1933) page 29.

Apparatus For Measuring Wall Thicknesses of Hollow Glass Vessels

By VIVIAN BIRD, Shrewsbury, Salop, England.

• THE PERSISTENT DEMAND of consumers for hollow glass vessels of lower wall strength, especially in the case of packing glasses, complicates manufacture since a thinner wall involves a greater uniformity of glass distribution. The difficulty of obtaining the desired uniformity during manufacture renders an appropriate form of production control highly desirable.

Many commonly used methods for assessing wall strengths or checking glass distribution are incapable of adequately meeting the demands of modern glass works. The equipment used is either relatively large and unwieldy or, if small and portable, involves time-wasting individual measurements on each work piece.

Fig. 1.

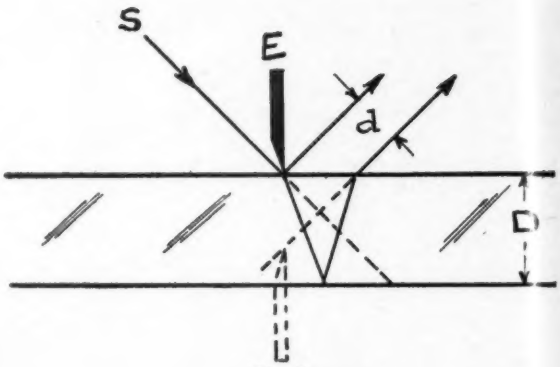

Fig. 2.

A new apparatus is claimed by the manufacturer, Dr. Heinrich Schneider, of Bad Kreuznach, Western Germany, to overcome these disadvantages.

The new measuring device is portable in form; its principle of operation will be understood by reference to Fig. 2. A straight edge *E* is placed on the outer surface of the hollow vessel. The incident light ray *S* undergoes reflection on the outer surface, and the refracted ray reflection on the inner surface of the wall, in accordance with the usual laws of optics.

The two rays thus formed pass to the eye-piece of the apparatus. The distance between the two rays serves as a measure for the thickness of the wall. Two images of the straight edge appear in the eye piece which incorporates a scale giving a direct reading of the thickness *D*. The measuring tolerance of the instrument is approximately ±0.1 mm within a total measuring range of from 0.2 to 10 mm.

Fig. 1 shows the apparatus in use. Its dimensions can be gauged by comparison with the 40-watt lamp shown, and it can be used for measurements on any transparent body, including colored glass and synthetic materials.

The main advantage of the apparatus is its compact form. No adjustments are necessary when using. As a result the apparatus and test piece can remain in continuous contact during the measuring operation, making it possible to obtain an accurate picture of the entire glass vessel under examination.

Interpretation of Glass Stability

• THE NATIONAL BUREAU OF STANDARDS has recently analyzed glass stability in terms of phase diagrams, shedding additional light on the glass forming process and on the structure of multi-component glasses[1]. This work contributes to present glass theory by indicating that distinct chemical entities exist in glass. Of practical use as well is the related finding that stable glasses are usually found in areas of a phase diagram where the liquidus curve or surface is flat—an indication of a highly dissociated compound.

Since stable glass formation is directly opposed to crystallization or devitrification, studies of glass stability include a determination of the factors affecting crystallization. One is the liquidus temperature—the highest temperature at which molten glass and the crystalline phase can coexist in equilibrium. Another is the rate of crystal growth at various temperatures; a third is the seeding or nucleation time required for crystal growth to start.

In the present research by G. W. Cleek and E. H. Hamilton of the Bureau's glass laboratories, the liquidus temperature was determined for various compositions so that liquidus curves could be plotted. A comparison of liquidus data with observed glass-forming ability provided a basis for structural interpretation.

In the experimental part of this work glasses of the following types were investigated: barium borosilicate, sodium titanium silicate, barium titanium silicate, zinc borosilicate, barium lanthanum silicate, barium tantalum silicate, and calcium aluminate glasses. Studies were also conducted on more complicated glasses made by introducing other oxides, including the rare earth oxides, into these simpler glasses.

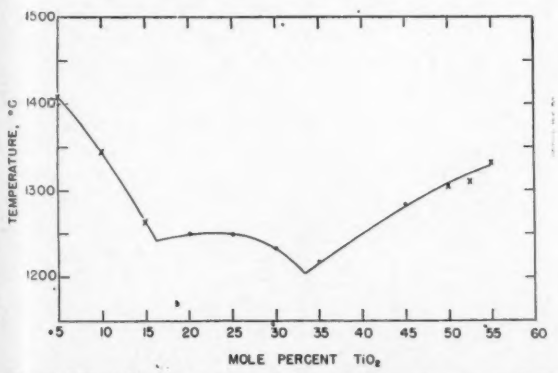

Fig. 1. Liquidus curve for melts in the 25 mole percent BaO isopleth in the barium titanium silicate system. Glasses are obtained on the central relatively flat section of the curve and on a portion of the steeper right section. The left section, being steep, does not lend itself to glass formation. Compositions that cooled as homogeneous glasses (·) and compositions that cooled as a mixture of glass and crystals (x) are indicated.

The procedure adopted to test stability involved melting the glasses in 500- to 600-g melts and attempting to cool these melts as homogeneous glass blocks 3 in. long by 3 in. wide by ½ to ⅝ in. deep. Only compositions in which no devitrification occurred during cooling were considered to be glass forming. Only those compositions which melted below 1500°C were studied. To insure uniformity the melts were stirred with rotating double-bladed platinum-10-percent-rhodium stirrers for two hours before being cast into the blocks. The glass forming area thus defined was plotted on a composition diagram for interpretation.

In determining the liquidus temperature of various compositions a special holder, originally developed at the Bureau, was used.[2] This apparatus consists of an inverted platinum-10-percent-rhodium trough 5½ in. long by ½ in. wide. Small open cells tapering from a 2-mm diameter top to a 1-mm diameter bottom are spaced along the length of this holder. Crushed glass in pieces about 2 mm long and 1 mm wide is loaded into these holes, and the holder is positioned in a furnace with a known temperature gradient. Since the distance between holes

(*Continued on page* 452)

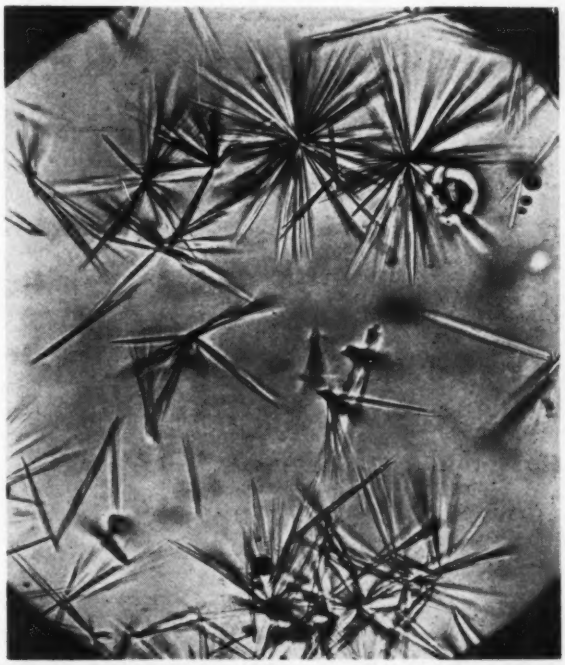

Fig. 2. Photomicrograph of crystals formed from a glass appearing in one of the cells of the holder used at the National Bureau of Standards in determining liquidus temperature. From size determinations of these crystals the rate of crystal growth can be estimated.

MORFOOT RETIRES FROM OWENS-ILLINOIS

Frank G. Morfoot is retiring as assistant secretary-treasurer of Owens-Illinois Glass Company, after 46 years in the glassmaking industry. He began his career in 1912 in the Alton, Ill., factory of the Illinois Glass Co., where he worked 10 hours a day for 10 cents an hour packing hand-blown bottles for shipment.

Mr. Morfoot recalls that the glass blower was king when he started in the industry, and he remembers the installation of one of the first automatic bottle machines,

Frank G. Morfoot, center, retiring as assistant secretary-treasurer, Owens-Illinois Glass Company, accepts scroll honoring his 46-year association with the company. William E. Levis, right, former board chairman and director, presents scroll to Mr. Morfoot, while Palmer W. Hancock, vice-president, looks on.

invented by Michael J. Owens. By 1929, when Mr. Morfoot went to Toledo, following the merger of Illinois Glass and the Owens Bottle Company, the blow pipe was on the way out.

Close friends and business associates honored Mr. Morfoot at a luncheon last month. Among those present were William E. Levis, former board chairman and a director of Owens-Illinois; Palmer W. Hancock, vice-president; F. M. Canter, comptroller; and E. E. Smith, treasurer.

SAFETY MANAGER, PITTSBURGH PLATE

Clyde C. Ruddick has been appointed manager of safety, health and plant protection by Pittsburgh Plate Glass Company, succeeding the late Thomas R. Donoghue, who had served in that position since 1946. He joined the company in 1951 as assistant manager, under Mr. Donoghue.

FOAMSIL, A NEW REFRACTORY MATERIAL

Pittsburgh Corning Corporation has created an entirely new acid-resistant insulating and refractory material by causing pure silica to boil and foam. Called Foamsil, the new material is 99 per cent pure fused silica; it cannot oxidize or absorb moisture and is not affected by any acids except hydrofluoric and hot phosphoric.

The insulating value of one inch of Foamsil is equivalent to that of 18 inches of acid brick at an operating temperature of 250°F. When subjected to intense heat, and then water-quenched, the material does not crack or spall; it does not warp, shrink or slump during rapid temperature changes.

Pittsburgh Corning is producing Foamsil in quantity at its Sedalia, Missouri, plant, in a special continuous horizontal electric furnace.

REPRESENTED BY WEST COAST TRADING

Joseph Kreuter K. G., a stamp and tool factory in Germany, has named the West Coast Trading Company, 111 North Western Avenue, Los Angeles, Calif., as its representative in the United States. The latter firm is an importer and distributor of colors, glazes and tool accessories used in ceramics and glass.

TWO OAKITE EXECUTIVES PROMOTED

Dr. Clarence Bremer has been appointed technical director of Oakite Products, Inc. and will be responsible for the company's research and product development, and the technical service laboratories. Formerly director of research, Dr. Bremer has been with Oakite since 1942, and a director since 1956.

William A. Baltzell, assistant sales manager, has been named industrial sales manager. Reporting to him will be the company's 17 divisions and 240 technical service representatives throughout the United States and Canada.

BRUMBAUGH, V.P., DIAMOND ALKALI

C. C. Brumbaugh, director of engineering, Diamond Alkali Company, has been appointed a vice president. He will be responsible for the engineering, research and related technical aspects of the business. He has been succeeded by Robert C. Sutter, formerly operations manager of the chlorinated products division.

Since 1954 Mr. Brumbaugh has also been active in the design and development of Holland's first soda ash plant at Delfzijl, which was put into operation in December, 1957.

CHARLES F. RYAN

Charles F. Ryan, a consulting engineer and former executive of the Hartford Empire Company, died suddenly on July 5 while visiting friends in Wethersfield, Conn. He was 71.

A former superintendent of the Thatcher Glass Manufacturing Co., he later joined Hartford Empire where he worked for 15 years. Several years ago he became a consulting engineer in the glass furnace engineering industry and traveled throughout the world.

JAKE EAGLE

Jake Eagle, manager of color sales, Pemco Corporation, died June 29 at the age of 59. He was known throughout the industry for his vast knowledge of ceramics, especially in colors. A graduate of Alfred University, he was a charter member of the Institute of Ceramic Engineers and a fellow of the American Ceramic Society.

Jake Eagle

Prior to his association with Pemco, Mr. Eagle had been with Vitro Manufacturing Company and with Mosaic Tile and the Cambridge Tile Company. During World War II he was chief of the non-metal section of the War Production Board.

Inventions and Inventors

Annealing and Tempering

Article Conveying and Transfer Apparatus. Patent No. 2,801,726. Filed October 14, 1954. Issued August 6, 1957. Three sheets of drawings; none reproduced. Assigned to Owens-Illinois Glass Company by Clarence Chew.

The invention is of utility in the manufacture of glass bottles, jars, and other articles and is used for transferring glass articles from one conveyor to another during the passage of the articles from a forming machine to the annealing lehr.

The apparatus comprises a horizontally traveling, endless belt conveyor by which articles such as glass bottles or jars, discharged from the molds of a forming machine are carried to a transfer station. A second horizontally traveling endless belt conveyor is mounted on a conveyor frame, the receiving end of which is adjacent to the discharge end of the conveyor. The two conveyor belts have their upper stretches extending in substantially the same horizontal plane. The conveyor extends in a direction approximately at right angles to that of the conveyor. The articles during the transfer are pushed across a stationary dead plate between and in the horizontal plane of the conveyor belts. The articles as they are received on the conveyor are advanced to form a row extending across the receiving end of the annealing lehr to which the rows of articles are transferred. This transfer mechanism includes an endless chain mounted on a vertically disposed frame.

Attached to the chain at equally spaced intervals are finger-like projections, or rods, which project laterally from the chain. During their travel with the lower stretch of the chain they are directly over, and spaced a short distance above, the conveyor belt.

There were seven claims, and the following reference was cited, in this patent: 2,142,271, Herrman, Jan. 3, 1939.

Glass bending apparatus. Patent No. 2,814,164. Filed October 3, 1952. Issued November 26, 1957. Three sheets of drawings; none reproduced. Assigned to Libbey-Owens-Ford Glass Company by Frank J. Carson and Gerald White.

This invention relates broadly to the bending of sheets or plates of glass to a desired curvature. More particularly, it relates to an improved multi-section, hinged type bending mold.

Arms are associated with the opposite end sections of a hinged type bending mold so as to be movable therewith during swinging of the mold from the open to the closed position. These arms are disposed at only the sides of the mold to which the unbalanced sheet will tend to slip and, in the open position of the mold, will be elevated above said mold to a point at least approximately level with the locating means by which the extreme ends of the sheet are supported. During movement of the mold, and particularly the end sections thereof, the arms will be caused to move downward below the shaping surface of the mold to permit said sheet to properly conform thereto.

By means of these arms then, the glass sheet being bent is prevented from tilting to one side and slipping from its properly supported position relative to the mold. In being caused to move downward from their elevated positions, the ends of the arms will substantially lead the bending glass sheet so as to permit it to conform freely to the curvature of the mold shaping surface.

At the outer ends of the endmost sections of the mold, locating means for the apices of the sharply "V"-shaped end portions of the glass sheet to be bent are mounted on said sections so as to be universally movable with respect thereto. In this manner, said means maintain their wedging effect on the end portions of the sheet as said sheet bends into conformity with the mold and said end portions constantly change in angular relation with respect to the side portions of the sheet.

There were 12 claims and the following references cited in this patent.

United States Patents

833,436, Borland et al., Oct. 16, 1906; 1,999,558, Black, Apr. 30, 1935; 2,223,124, Owen, Nov. 26, 1940; 2,261,023, Galey, Oct. 28, 1941; 2,518,951, Smith, Aug. 15, 1950; 2,551,606, Jendrisak, May 8, 1951; 2,553,572, Jendrisak, May 29, 1951; 2,608,799, Babcock, Sept. 2, 1952; 2,674,064, Reggiani, Apr. 6, 1954; 2,683,334, Rugg et al., July 13, 1954.

Feeding and Forming

Machine for Manufacturing Tubular Lamps. Patent No. 2,798,514. Filed March 28, 1952. Issued July 9, 1957. No drawings. Assigned to Westinghouse Electric Corporation by Daniel Mullan.

This invention relates to sealing mounts into tubular bulbs while held in clamps on an indexing conveyor thereof, moving said bulbs axially to elevated position in said clamps, separating the lead wires at the lower ends of said bulbs, and releasing said clamps for allowing withdrawal or return to said machine in reverse position.

The machine for manufacturing tubular lamps provides a pair of bulb-raising jaws, cam-operated through levers and a gear, which move forward and close about a bulb. Then the jaws rise to remove the exhaust tube at the lower end of said bulb from the mount holder to avoid breaking of the exhaust tube.

A further object is to provide a bulb-holding clamp for holding bulbs in position during processing, and a cam for operating said clamp to release the bulb while being raised by appropriate jaws and grip it after release by said jaws.

There were 2 claims and 16 references cited in this patent.

Feeding and Forming

Glass Forming Die. Patent No. 2,803,925. Filed October 25, 1951. Issued August 27, 1957. Assigned to Baker & Company, Inc. by Harry Klausmann.

A novel, fabricated glass forming die is shown. This die is used in contact with molten glass at an elevated temperature, the glass having a silica content of at least 70 per cent SiO^2 and being in such a state that it is capable of flowing and wetting the metal. The die is formed of an alloy consisting of 85 to 97.5 per cent rhodium and 2 to 5 per cent nickel, the balance being a metal selected from the group consisting of platinum, palladium and cobalt.

There were 4 claims cited in this patent.

Method Of Producing Multilayered Blown Hollow Glass Bodies. Patent No. 2,802,309. Filed October 28, 1949. Issued August 13, 1957. Assigned to (no assignee) by Herbert Brune.

A novel method of producing multi-layered hollow glass ware is presented. A plurality of different batches of glass is superimposed in layers in a primary mold to form a charge. The central portion of the charge is then depressed by a plunger to form a dish-shaped parison consisting of the superimposed layers of glass. The parison is then blown up to the desired shape or article.

There were 3 claims cited in this patent.

Glass Compositions

Electric Melting Furnace. Patent No. 2,804,492. Filed December 13, 1954. Issued August 27, 1957. Assigned to Jena'er Glaswerk Schott & Gen., Mainz, Germany by Carsten Eden.

The present invention relates to an electric melting furnace, particularly for the manufacture and treatment of glass, wherein the material melted, or to be melted, is heated at least partly by joulean heat.

Various designs of electric melting furnaces have been known in which the electrodes were immersed in the material melted, or to be melted. Such furnace designs had the very obnoxious disadvantage that the fused mass itself was polluted by the material of the electrodes, for example, carbon, and that the electrode material was used up very quickly, especially if the fused mass had a high concentration in anions. These disadvantages became apparent especially when the temperatures were raised as high as are usually required in this art.

An electric furnace is provided with one or more electrodes and one or more partitions spaced from said electrodes so as to form an intermediate chamber filled with a material having a different chemical composition than the mass to be fused or treated in the furnace.

Materials especially suitable for making the partition have been found to be compounds of silicic acid with metallic oxides as well as stabilized zirconium oxide.

There were 8 claims and the following references cited in this patent.

United States Patents

Re. 1,267,317, Erskine, May 21, 1918; Re. 1,815,978, Hitner, July 28, 1931; Re. 2,122,469, Hitner, July 5, 1938; Re. 2,594,972, Huehlenkamp, Apr. 29, 1952; Re. 2,697,130, Korbelak, Dec. 14, 1954.

Glasses Containing Oxides of Rare Earth Metals. Patent No. 2,805,166. Filed January 18, 1954. Issued September 3, 1957. No drawings. Assigned to (no assignee) by Johannes Löffler.

It has been found that by combining oxides of the rare earth metals with alumina and SiO^2, glasses consisting essentially of rare earth metal oxide-alumina-silicates are obtained, which can be melted at conventional glass-melting temperatures and show a low viscosity in molten condition. As the presence in conventional glass compositions of oxides of rare earth metals by themselves, as well as the presence of alumina by itself, causes an increase of viscosity of the molten glass, it was entirely unexpected that glasses consisting essentially of rare earth metal oxide-alumina-silicates would be low-melting and of low viscosity.

Thus, the glasses embodying the present invention are different from both of the above-mentioned known types containing rare earth metal oxides and represent a hitherto unknown, novel type, which is either substantially free from the conventional fluxing agents (alkali metal) oxides and boric acid) or contains only small amounts of the latter which are insufficient to exert a substantial fluxing effect.

A glass is prepared by the conventional procedure from a mixture of the following ingredients:

	Per cent
Nd_2O_3	32.5
Pr_2O_3	3.2
La_2O_3	18.3
BaO	2.0
PbO	7.9
Al_2O_3	9.0
K_2O	0.5
SiO_2	21.5
As_2O_5	0.1
B_2O_3	5.0

The oxides of the above rare earth metals can be partly or entirely substituted by oxides of other rare earth metals and the proportions of the individual oxides of rare earth metals can be varied.

There were 13 claims and the following references cited in this patent.

Foreign Patents

351,245, Great Britain, 1931 and 255,914, Switzerland, 1948.

Apparatus for the Manufacture of Arsenic Trisulfide. Patent No. 2,804,378. Filed October 5, 1953. Issued August 27, 1957. No drawings. Assigned to American Optical Company by Lee O. Upton.

The invention provides improved means and an improved method of producing such glass as may be fabricated by vaporization of the ingredients thereof and the subsequent condensation and solidification of said vaporization product such as, for example, arsenic sulphide glass or similar infrared transmitting glasses. The apparatus comprises cooperatively functioning distilling and condensing units in which raw arsenic and raw sulphur or arsenic sulphide cullet, or the like, can be converted into substantially pure glass in a continous operation. This involves a controlled reacting, melting, vaporizing, and condensing procedure using controlled

(*Continued on page* 447)

The Effect of Sand Grain Size on the Refining of a Pure Soda-Lime-Silica Glass

• IN THE FEBRUARY, 1958, issue of the *Journal of the Society of Glass Technology*, M. Cable reports the results of work undertaken to find the effect of sand grain size on the rate of refining of a simple soda-lime-silica glass. By following the variations with time of number of seed per cubic centimeter and the distribution of seed diameters, it was possible to compare the results with predictions based on the assumption that refining was effected by bubbles rising to the surface of the melt and bursting.

The particular glass composition used was chosen, as were the sand grain sizes, because Preston & Turner (1940) had investigated the effect of temperature and sand grain sizes on the batch-free time of this glass. Their paper thus indicated the shortest founding times to be used, while the longest were those at which the seediness had fallen to about $1/cm^3$. In the present work melting was done in an electrically heated furnace, and the technique of both melting and seed counting was very similar to that used by Bastick (1956a).

The three batch materials were sand grains sieved from Loch Aline sand and analytical reagent sodium and calcium carbonates. Details of the sieves used to separate the four sand fractions are given in Table I.

Table I

SIEVES USED TO SEPARATE THE SAND FRACTIONS

I.M.M. sieve number	Aperture mm	Average sand grain diameter mm
30	0.423	0.338
50	0.254	0.218
70	0.181	0.154
100	0.127	—
120	0.106	—
150	0.085	0.095

After sieving, all the fractions were water washed in an elutriator to remove fine dust, and then dried at 110°C. The two finest fractions were richer in iron than the other two and, if used after only water washing, produced glasses having a distinct yellow-green tint; they were therefore treated with hot hydrochloric acid before water washing. This greatly reduced the iron content, and no color could be detected by eye in any of the glasses in a thickness of about 5 cm.

The moisture content of the two carbonates was determined regularly and allowed for in weighing out the batch: the average moisture content of the mixed batch was 0.33 per cent with a total range of ±0.06 per cent. As Stanworth & Turner (1937) found that more than 4 per cent of moisture was needed to affect the rate of melting or refining of a soda-lime-silica glass, it was thought unnecessary to dry the sodium or calcium carbonate. These two materials were not sieved because they contained only small proportions that did not pass the finest sieve available (200 I.M.M., aperture 0.0635 mm). Also the work of Potts, Brookover & Burch (1944) showed that the sizes of these materials have less effect on the rate of melting than the size of the sand grains.

Each batch was weighed out and mixed separately, making 60 g of glass of composition, in weight per cent; 73.5 SiO_2; 10.0 CaO; and 16.5 per cent Na_2O. The largest impurity was expected to be Al_2O_3 contributed by the sand, and R_2O_3 determinations were therefore made on five glasses chosen at random, all of which contained less than 0.10 per cent R_2O_3. Melts with the finest sand boiled over if all the batches were put into the crucible at once. Two fills were therefore used for all melts. To minimize any errors that might arise the weights filled on, and the time interval between the fills, were kept constant; 45.0 g of batch were put into the crucible at the first fill and the rest added 6 minutes later.

The furnace used was heated by Silit rods and was fitted with a controller that kept the temperature within ±3° of 1400°C. A thermocouple hanging in the crucible with its tip about 1 cm above the surface of the glass was connected to a recorder and showed that the melt took between 10 and 15 minutes to attain 1400°C after putting in the first fill. The founding time was measured from putting in the first fill and, after the appropriate time had passed, the crucible was withdrawn and a circular slab of about 30 g poured onto an iron marver. This slab was then annealed. The crucibles were of platinum or platinum-rhodium alloy, about 6 cm tall, 4 cm in diameter at the base and 5 cm in diameter at the top.

Discs were cast from the melts and measurements of the total number of seed and their size distribution made on photographic enlargements of the annealed discs.

The following properties of importance are influenced by the size of sand grains used in the melting of glass:

1. batch-free time
2. homogeneity of the melt
3. seediness at the batch-free time
4. size distribution of seed at the batch-free time
5. rate of refining of a particular size of seed

Preston & Turner (1940) found that the batch-free time depended directly on the size of sand grain; that is, on the surface area of silica exposed. They also observed that only about one tenth of the batch-free time was occupied by vigorous reaction and the rest by solution of the remaining sand grains. Since the solution of these grains in the melt must produce silica-rich cords there is obviously an advantage in using finely divided silica.

A continuous improvement in homogeneity was found as the sand grain size decreased, and the improvement was most marked between the two finest fractions. The seediness at the batch-free time and the distribution of seed diameters depend on several factors that have not yet been investigated. The processes that determine these two properties are those operating during the initial reaction of the batch.

That the seed number should increase as the surface of silica exposed for reaction increases is reasonable, as is the fact that more large seed were formed as the initial reaction became more rapid and the gas was evolved more

quickly. The homogeneity of the melt determines its effective viscosity and equilibrium gas content, while the rate of reaction may influence the quantity of gas retained. It is therefore not surprising that the sand grain size affected the rate at which a particular size of bubble disappeared.

Decreasing the sand grain size increased the number of seed formed but shortened the batch-free time, increased the rate at which a particular size of bubble disappeared, increased the average size of seed, and so the rate of refining, and also improved the homogeneity of the melt. As a result, well-refined and homogeneous glass was produced most quickly by using the finest sand. Most workers who have studied either melting or refining have considered them as two separate processes, and this division is a natural one to make because of obvious differences in the processes and in the experimental methods used. However, the work reported here has clearly shown that this division is an artificial one; refining cannot be fully understood without studying the reactions resulting in the formation of the melt.

OWENS-ILLINOIS EXECUTIVE APPOINTMENTS

Elliot R. Owens has been appointed vice president and technical director, Glass container division, of Owens-Illinois Glass Company. He will supervise all research

Elliot R. Owens

Eliot Marr

and engineering for the three divisions which comprise the O-I Glass Container Division—eastern glass container, Pacific Coast, and closure plastics.

Eliot Marr succeeds Mr. Owens as vice president and general factories manager of the Pacific coast division.

BECKEMEYER WITH INTERNAT. MINERALS

Harry J. Beckemeyer has been appointed technical service representative in the consolidated feldspar department of International Minerals & Chemical Corporation. He has just joined the company after seven years as a senior research engineer with Universal-Rundle Company, New Castle, Penna. Prior to that he had been assistant professor in the ceramic engineering department at Iowa State College from 1946 to 1951.

AMER. POTASH MOVES TO NEW BUILDING

American Potash & Chemical Corporation now has its headquarters in a newly constructed building at 3000 West Sixth St., Los Angeles. All of the company's executive offices are in this new location, including production, sales, administration, research, planning and development, and the defense and finance departments.

FORMS GLASS TECHNOLOGY SECTION

American Potash & Chemical Corporation has formed a glass technology section under the direction of Victor C. Swicker, a private glass consultant. Mr. Swicker was formerly in the optical glass section of the U. S. Bureau of Standards and was also associated with the Hartford Empire Division of Emhart Manufacturing Company.

The company has organized this new section, states William M. Clines, western general sales manager, because of the increasing role which American Potash products are playing in glass manufacturing.

BRENNER RETIRES, ANCHOR HOCKING

R. F. Brenner has retired from Anchor Hocking Glass Corporation as head of the chemical research and development laboratory and has been succeeded by P. D. Dilliard, his former assistant. Mr. Brenner was associated with Anchor Hocking since 1937. He had previously been with du Pont (1931-1937) and with the Owens Bottle Company (1926-1931), as well as the Torrance Glass Company, H. C. Fry Glass Company, and the Vitrolite Company.

Mr. Dilliard joined Anchor Hocking in 1942, having been with Sharp-Schurtz Co. the preceding six years.

PITTSBURGH PLATE APPOINTMENTS

H. W. Garnder, formerly chief electrical engineer, has been appointed assistant chief engineer-project and plant service manager, Pittsburgh Plate Glass Company. John A. Berseth, formerly assistant chief electrical engineer, succeeds Mr. Garnder.

Clifford H. Swensen has become chief power engineer, a new position in the company. He is currently serving as field engineer and local construction manager for the company's new window glass plant under construction at Decatur, Ill.

Robert J. Price, formerly assistant chief engineer, has become assistant chief engineer-chief mechanical engineer.

These promotions are a result of a new project and plant liaison section which Pittsburgh has established in its glass division engineering department.

HOMMEL RESEARCH CENTER

The new research center of the O. Hommel Company, directly opposite the main offices in Carnegie, Penna., has almost been completed. It will add more than 20,000 square feet of research facilities for extensive ceramic research and development. Special provision has been made for both static and dynamic testing of high temperature ceramic coatings.

Among the projects to be continued and undertaken in the new research center are the development of better porcelain enamel finishes for household appliances, improvement of high-temperature ceramic for aircraft and missiles, and research work in area lighting in conjunction with major electrical companies.

The Hommel Research Center will augment the company's "Oscar Hommel Memorial Fellowship," now in its 25th year at the Mellon Institute in Pittsburgh. This fellowship for basic research in ceramic frits and chemicals was started by the late Oscar Hommel, company founder, in 1933.

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during May, 1958, was as follows: *Flat Glass*: a preliminary figure of 22,400 given for May, 1958, indicates a decrease of 4.7 per cent from the adjusted 23,500 reported for April, 1958. *Glass and Glassware, Pressed and Blown*: An increase of 1.4 per cent is shown by the preliminary figure of 78,500 reported from May, 1958, when compared with the adjusted figure of 77,400 recorded for April, 1958. *Glass Products Made of Purchased Glass*: The preliminary figure of 12,000 given for May, 1958, indicates a decrease of 2.4 per cent from the previous month's adjusted figure of 12,300.

Payrolls in the glass industry during May, 1958, were as follows: *Flat Glass*: A decrease of 4.4 per cent is shown in the preliminary $10,199,951.33 given for May, 1958, when compared with April's adjusted $10,671,312.40. *Glass and Glassware, Pressed and Blown*: an increase of 2.5 per cent is shown in the preliminary $28,813,301.76 reported for May, 1958, when compared with the previous month's adjusted $28,121,126.67. *Glass Products Made of Purchased Glass*: a preliminary figure of $3,577,844.76 was reported for May, 1958. This is a decrease of 1.1 per cent when compared with the adjusted figure of $3,617,725.69 for April, 1958.

GLASS CONTAINER SHIPMENTS

(All Figures in Gross)

Narrow Neck Containers

	June, 1958
Food	1,198,000
Medicinal and Health Supplies	1,224,000
Chemical, Household and Industrial	805,000
Toiletries and Cosmetics	768,000
Beverage, Returnable	965,000
Beverage, Non-Returnable	131,000
Beer, Returnable	454,000
Beer, Non-Returnable	1,013,000
Liquor	817,000
Wine	342,000
Sub-total (Narrow)	7,717,000

Wide Mouth Containers

Food	*3,564,000
Medicinal and Health Supplies	337,000
Chemical, Household and Industrial	140,000
Toiletries and Cosmetics	226,000
Packers' Tumblers	51,000
Dairy Products	141,000
Sub total (Wide)	4,459,000
Total Domestic	12,176,000
Export Shipments	200,000
TOTAL SHIPMENTS	12,376,000

*This figure includes Fruit Jars and Jelly Glasses.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All Figures in Gross)

		Production June, 1958	Stocks June, 1958
Food, Medicinal and Health Supplies; Chemical, Household and Industrial; Toiletries and Cosmetics	Narrow Neck	4,299,000	7,165,000
	Wide Mouth	*4,471,000	*6,245,000
Beverage, Returnable		948,000	1,967,000
Beverage, Non-Returnable		196,000	303,000
Beer, Returnable		399,000	353,000
Beer, Non-Returnable		1,004,000	740,000
Liquor		858,000	1,268,000
Wine		349,000	650,000
Packers' Tumblers		63,000	133,000
Dairy Products		134,000	321,000
TOTAL		*12,721,000	*19,145,000

*This figure includes Fruit Jars and Jelly Glasses.

Glass Container Production: Production based on figures released by the Bureau of the Census, Industry Division, was 12,721,000 gross during June, 1958. This is an increase of 4.3 per cent over the previous month's production figure, 12,201,000 gross. During June, 1957, glass container production was 12,801,000 gross, or 0.6 per cent above the June, 1958, figure. At the end of the first six months of 1958, glass container manufacturers have produced a preliminary total of 70,909,000 gross. This is 2.7 per cent below the 72,882,000 gross produced during the same period in 1957.

Shipments of glass containers during June, 1958, came to 12,376,000 gross, an increase of 1.1 per cent over May, 1958, shipments which totaled 12,508,000 gross. Shipments during June, 1957, amounted to 12,295,000 gross, or 6.5 per cent below June, 1958. At the end of the first six months of 1958, shipments have reached a preliminary total of 68,927,000 gross, which is 1.0 per cent over the 68,213,000 gross shipped during the same period of the previous year.

Stocks on hand at the end of June, 1958, came to 19,145,000 gross. This is 1.7 per cent above the 18,825,000 gross on hand at the end of May, 1958, and 0.08 per cent higher than the 18,131,000 gross on hand at the end of June, 1957.

McKEE NAMES EXPORT REPRESENTATIVE

The McKee division of Thatcher Glass Mfg. Co., Inc. has appointed S. F. Appliances Limited, Paterson, N. J., as worldwide export representative. The latter company will handle the sale of Glasbake ovenware giftware and McKee crystal and milk glass throughout the free world.

AMERICAN POTASH PROMOTES THREE MEN

As a result of the recent merger of Lindsay Chemical Company with American Potash & Chemical Corporation to form the Lindsay Chemical Division, at West Chicago, Ill., three promotions have been made. George T. Deck has become vice president and technical general manager. He has been succeeded by Russell S. Sunderlin as plant manager of the Texas plant of American Potash, while Harold Mazza replaces Mr. Sunderlin as manager of the Los Angeles plant.

New Equipment and Supplies

BENCH WELDER

Eisler Engineering Co., Inc., Newark, N. J., has developed a small vertical precision press-type bench welder suitable for welding very small, intricate parts for the electronic industry.

By changing the welding tips, it is possible to make 35 to 50 different welding combinations.

BIN VIBRATORS

Eriez Manufacturing Company, Erie, Penna., has announced a new series of bin vibrators especially designed for pin-point installation on bins and hopper up to 14 cu. ft. in capacity. When materials show a tendency to pack, bridge or stock in bins or chutes, the trouble can be overcome by applying one of the vibrators at the precise point of difficulty, where its concentrated vibratory action will permanently insure a continuous, smooth flow of material.

MONITORING SYSTEM

Electric Regulator Corporation, Norwalk, Conn., has an electric monitoring system which detects variations in conditions of voltage, frequency, and phase in any power source and is capable of operating contactors, switches, alarms, or other devices in response to these conditions.

Called the Monitor, Model 4.010, this system relays a signal to a visible or audible alarm, or both, in order to indicate the nature of the fault whenever a shut-down or switch-over occurs. In this way, it can be used to protect any load from power faults either by de-energizing it or by switching it to another source of power.

MACHINE FOR LAMP COMPONENTS

Kahle Engineering Co., North Bergen, N. J., has designed an automatic glass tubing cutting machine for the Monterrey, Mexico, plant of Lamperas General Electric de Mexico, S.A. de C.V. This machine makes it possible to have a more completely integrated operation for manufacturing all types of miniature lamps used in flashlights, radio and automobile panels. Designed to G. E. specifications, the machine is used to chill cut soft glass tubing through which gasses are drawn to form a vacuum.

GAS-FIRED HAND TORCH

Selas Corporation of America, Dresher, Pa., has a new line of gas-fired hand torches which, the company says, offer flexibility, controlled flame characteristics, long life, and simple, low-cost maintenance for localized pointed flame heating. They are designed for use in glass working, glass ampoule sealing and other applications. This hand torch combines a die-pressed, kiln-fired perforated refractory screen with a heat-resistant alloy pilot ring.

FURNACE FOR TEST FIRING

Harrop Electric Furnace Division of Harrop Ceramic Service Co., Columbus 19, Ohio, has developed a furnace for laboratory test firing in the intermediate temperature range between 2000°F and 2300°F, depending on which of the two models are used.

Either model—MR-18C or MRH-18C—provides a setting space 18″ x 18″ x 19″ high, and is wired for 220 volt single-phase power supply.

Harrop has also designed a large electric furnace (Model MR-30-CNB) for any low-temperature operation, such as annealing glass or decorating glass and ceramic ware. It is equally useful for testing in the temperature range up to 1500°F. Setting space is 30″ x 48″ x 30″ high.

ACTIVATION ANALYSIS

Nuclear Science and Engineering Corporation, Pittsburgh, Penna., has developed an analytical tool by which extremely minute quantities of materials can be detected and measured through the use of radioactivity. This tool, activation analysis, enables NSEC scientists to determine the presence of one part per billion of boron in silicon.

It permits quality control in the manufacture and processing of chemicals, alloys, metals and in many other areas in which control of trace elements in small quantities is necessary.

This activation analysis service is now available on a broad scale to industrial organizations. Additional information is available from the company at Department R, Box 10901, Pittsburgh 36.

CATALOGS RECEIVED

Cratex Manufacturing Company, Burlingame, Calif., has issued an 8-page industrial catalog of rubberized abrasives for deburring, smoothing and polishing which contains operating instructions, applications, illustrations and technical data.

The United Electric Controls Co., Watertown, Mass., is distributing a new 8-page catalog on pressure-vacuum controls. It describes a wide variety of pressure-vacuum controls featuring general purpose, sensitive, extremely sensitive, dual switch differential, absolute and explosion-proof units.

The Society of Glass Technology, Thornton, Hallam Gate Road, Sheffield 10, England, has just published the book, "Glass-Melting Tank Furnaces," by Dr. Ing R. Gunther which was translated from the German by John Currie. Dr. Gunther's original book was published in 1954 by the Deutsche Glastechnische Gesellschaft, and this second book has been published by agreement with the German Society. The text has been rearranged and divided into eleven chapters: 1) Introduction; 2) Types of Furnaces; 3) The Essential Operations of Tank Furnaces; 4) Constructional Details; 5) Heat Recovery: Regeneration and Recuperation; 6) The Control of Gaseous Flow; 7) Control Equipment; 8) Heating and Cooling the Furnace; 9) Furnace Capacity and Fuel Efficiency; 10) Fundamental Thermal Calculations; 11) History of the Tank Furnace.

Copies are available from the Society of Glass Technology at $9 each.

The Cobalt Information Center has prepared a revised, bound edition of the bibliography, "Cobalt and its Alloys." The section on allotropy contains more than 90 references to literature from 1911 to 1958. In addition, there are two-color phase diagrams for the cobalt binary alloys, as well as more than 900 references to binary, ternary and quaternary systems.

Copies of this 125-page reference work are available from the Cobalt Information Center, c/o Battelle Memorial Institute, 505 King Ave., Columbus 1, Ohio. They are available overseas from the Centre d'Information du Cobalt, 35, rue des Colonies, Brussels, Belgium.

Here's why WEST END can answer your inquiry on shipments immediately!

When you phone an order or request information, the Sales Office Manager in Oakland with whom you speak can contact the plant at WEST END immediately.

He talks by private wire teletype with the shipping superintendent on dates, packaging, transport facilities, car numbers. An answer or firm commitment is given immediately. It is relayed to you often while you are still on the phone.

WEST END's Sales Office Manager sales representatives and plant executives work together as a team manning a system that is, in our opinion, uniquely outstanding in the chemical industry. Their confidence in the efficiency of this system is reflected in the enthusiastic, helpful and friendly manner in which they promptly serve you . . . our customers.

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SODA ASH
SODIUM SULFATE
BORAX • HYDRATED LIME

Testing Glass for Strength

(*Continued from page* 425)

from one and the same initial glass. For this, samples of lesser thickness were prepared from 7 mm. rolled glass by grinding and polishing. The same thing was done with 5 mm. vertically-drawn glass. The results of experiments with samples of varying thickness of a size 120 by 25 mm are shown in Table IV. In each group about twenty samples were tested.

A comparison of the results of the investigation of the dependence of strength upon size of samples, Table III, and its thickness, Fig. 3, shows that these values depend upon thickness to a larger degree than upon its other dimensions.

Our hypothesis that a difference of strength in thin and thick glasses is conditional by an insufficient accuracy of the formula used for calculating when applied to these glasses does not permit a complete explanation of the phenomenon shown above. This may be seen from the following argument.

In the bending of a bar or beam (C. P. Timoschenko and Lessel, "Applied Theory of Elasticity," edition of 1931) stress in a longitudinal direction is accompanied by a transverse deformation. In consequence of this, the form of all transverse sections of a bending beam is distorted. Normal stresses in the case of bending will be: $P = Ey/\rho$ where y is the distance of the element of area from the neutral axis;

ρ is the radius of curvature of the neutral surface; and E is Young's modulus.

In the bending of a thin strip, transverse deformations take place only near the edges. The equation in this case takes the form: $P = \frac{Ey}{(1-\mu)}$ Where μ is Poisson's ratio. This means that the strength of a square in bending on a cylindrical surface is increased in the ratio $1/(1-\mu)$. For glass $\mu = 0.22$ and $1/(1-\mu) = 1.05$.

From this calculation it follows that the value of strength of very thin glass plates calculated by the formula for beams exceeds by 5 per cent the true value. In Fig. 3 it is seen that the value of the strength of thin samples of glass is greater than thick ones, not by 5 per cent, but by several times.

The dependence of the value of the strength of glass upon thickness of samples to some degree may be explained by the fact that the breaking of glass begins at the edges, that is, from the places most weakened by cutting and the mechanical working of the blocks. Consequently, very dangerous defects are to be found on the surfaces of the blocks, but the size of these defects on the surface is determined by the thickness.

Apparently the speed of cooling in the process of forming shows an influence on the strength also. Bartenev and Invanova, *Steklo e Keramika*, 12, 1955).

Calculation of the influences of the above factors upon the strength of glass and the maintenance of stable conditions of testing, selection, and preparation of samples are necessary in investigating strength of glass and in comparing various kinds of glass.

NORELCO SCHOOL AT SAN FRANCISCO

The Norelco Diffraction School will hold its 31st session during the week of September 8, at the Sir Francis Drake Hotel, San Francisco. Registration for the one-week course will be limited to 125 for the first four days, and to 150 on Friday, the day devoted to actual application problems when guest speakers will deal with current methods used in modern plants.

Basic subjects covered by prominent educators and scientists include X-ray diffraction, diffractometry and spectrography. There is no registration fee.

ENTRIES FOR CHESTERMAN AWARD

The American Bottlers of Carbonated Beverages is now accepting entries for the Chesterman Award of $1000 which will be presented to the person or persons who have made the most outstanding scientific or technical contribution to the progress and advancement of the soft drink industry during the year of the Award.

Entries of this year's award must be postmarked prior to midnight, December 31.

Those eligible to receive the award are technical men in the soft drink field and related industries, college technical men, post-graduate students and independent research workers.

Last year's award was conferred on James P. Poole, Ph.D., research director of the Brockway Glass Company, in recognition of his research and development work on a process of surface coating glass containers with silicones for protective purposes, including his numerous published papers on that subject.

FRAZIER-KERAMOS LIBRARY

The Pennsylvania State University Chapter of Keramos is naming its new library the Frazier-Keramos Library, in honor of one of its members, John Earl Frazier. The Chapter of Keramos—the National Scholastic Honorary Fraternity of Ceramic Engineering—is making this library a part of the Department of Ceramic Technology, College of Mineral Industries.

Mr. Frazier was chairman of the scholarship committee of that University Department from 1954 to 1958 and is now serving as committee vice chairman.

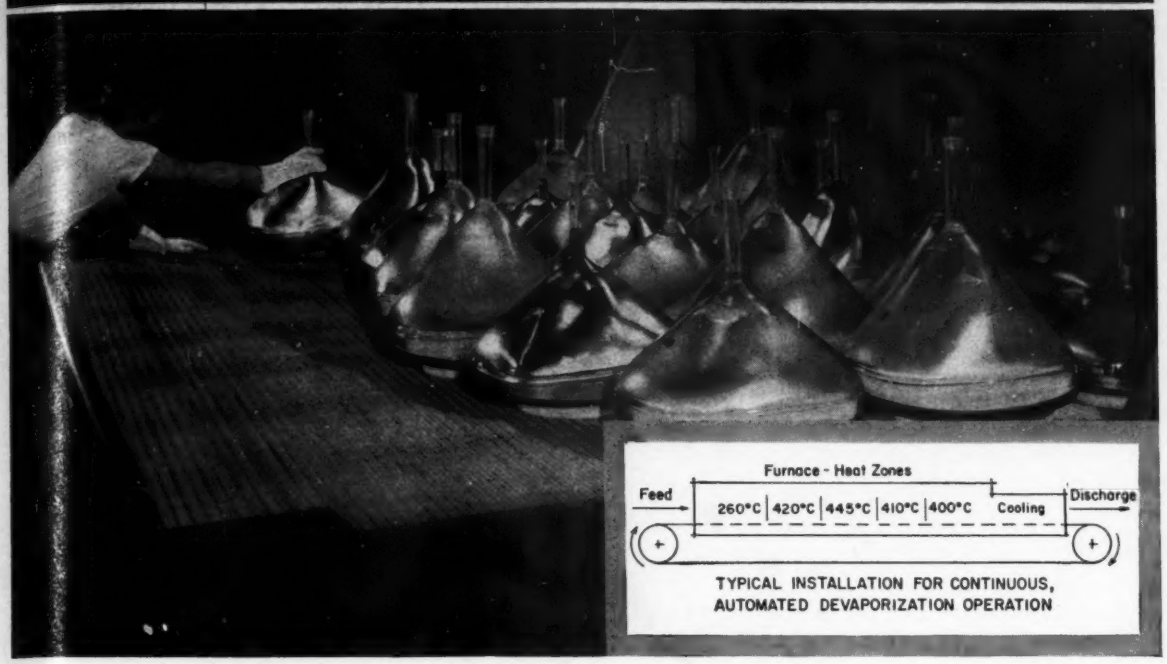
Dr. G. W. Brindley heads the Department of Ceramic Technology, and Dr. D. R. Mitchell is acting Dean of the College of Mineral Industries of Pennsylvania State University.

NEW RESEARCH LAB. FOR HAYWARD

Hayward Scientific Glass Corporation, Whittier, Calif., has completed its new research laboratory for melting special glasses in platinum crucibles. The primary purpose of the laboratory will be to develop and produce three types of glasses: those for special and strategic application, such as the rare element types; those seldom manufactured, solely because of normal lack of demand; and glasses normally produced in the United States but momentarily not available in the size and quality of pieces needed or in the rigid refractive index tolerances required.

New formulas may be developed in small melts, yielding five to ten pounds of glass; then large melts can be made to provide production quantities.

Cambridge WOVEN WIRE BELTS



TYPICAL INSTALLATION FOR CONTINUOUS, AUTOMATED DEVAPORIZATION OPERATION

METAL-MESH BELTS RESIST CONSTANT TEMPERATURE CHANGES TO LOWER PRODUCTION COSTS

It takes *five* separate heat zones to properly "bake" television tubes and assure top performance—that's why Cambridge Woven Wire Belts were selected to do the job. Cambridge Belts are built to take temperatures up to 2100° F. without effect . . . built to operate over long periods of time, even under conditions where temperatures fluctuate. Open mesh construction assures fast, uniform processing because atmospheres pass through the belt and around the product.

In the production of ceramics, whiteware and tile, too, Cambridge Belts can speed annealing, decorating, washing and inspection operations as they increase product uniformity and cut operating costs. Here's how:

CONTINUOUSLY MOVING BELTS ELIMINATE BATCH PROCESSING—give faster, more economical production by reducing slow, costly manual handling.

ALL-METAL CONSTRUCTION IS HEATPROOF, COLD-PROOF, RUSTPROOF—Cambridge belts can be woven from any metal or alloy to take sub-zero or up to 2100° F. temperatures, yet resist corrosion in wet operations. They can't absorb oil or grease and clean easily to prevent marking or discoloration of ware. Because they have no seams, lacers or fasteners, Cambridge Belts give longer service, reduce belt maintenance and replacements.

OPEN MESH PROVIDES FREE AIR, LIQUID CIRCULATION—products are washed, dried, cooled faster, more uniformly. Solutions drain through belt immediately.

SPECIAL SURFACE ATTACHMENTS AVAILABLE—cross flights or raised edges keep product on belt during movement.

Talk to your Cambridge Field Engineer soon—he'll explain the many advantages of continuous ceramic or glass processing on Cambridge Woven Wire Belts. He'll also recommend the belt size, mesh or weave—in the metal or alloy—best suited to your operations. You'll find his name in the classified phone book under "BELTING, MECHANICAL". Or, write for FREE 130-PAGE REFERENCE MANUAL giving mesh specifications, design information and metallurgical data.

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DEPARTMENT K, CAMBRIDGE 8, MARYLAND

OFFICES IN PRINCIPAL INDUSTRIAL CITIES

Radiant Gas Heat . . .

(*Continued from page* 427)

well as the walls, become quite hot and reradiate sufficient heat to the glass to cause it to sag.

Instrumentation Assures Precise Heating Control

As indicated above, the right temperatures at the right time in the right location are a must for the successful precision production of curved glass. Permaglass has taken every means to assure such precision production with its complete and accurate instrument control for the two Duradiant furnaces.

The gas-air flow to each burner can be adjusted and set for any given run, and a thermostatically-controlled main supply line valve (Fig. 7) is provided for each pair of zones. Governed by a thermocouple and a pyrometer setting, this valve reduces or increases gas-air flow as needed. The furnace operator, who uses a gauge to check the curvature of glass when it is unloaded, can easily alter the pyrometer setting to vary the curvature of subsequent glass pieces, if necessary.

Selas fire-checks are located in the main outside the plant and at each furnace, in addition to the automatic valves, for control of flow to the respective sets of burners.

An instrument that is set to anticipate overheating is also included on the panel and is used in combination with a gas valve. If the valve should not function properly, another instrument will shut off the gas supply to the furnace when the temperature reaches 1600°F.

This precision method for making curved glass for television, automobiles, boats, and other products is an example of how Gradiation heating is solving some of the more complicated manufacturing problems and is proving the most economical answer to modern heat processing.

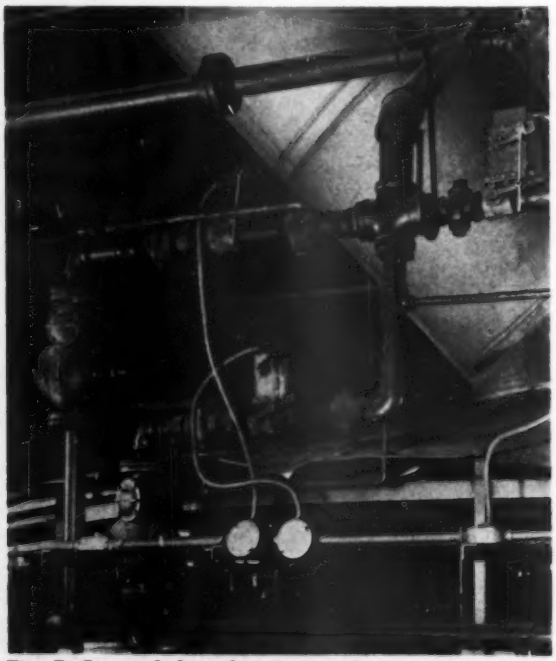


Fig. 7. Some of the valves for regulating gas-air mixture flow to burners in heating zones of continuous glass bending furnace. Regulation is automatic; temperature can be altered by panel controls, if desired.

Ancient and Modern Diatreta

(*Continued from page* 429)

tempts to be a failure, Weidmann decided to approach the problem on his own. After much close-hand examination of ancient specimens of glass he concluded that the ancient glass cutters (diatretarii) were far inferior in their abilities to the glass makers (vitriarii) of the same period, making it unlikely that the diatretarii had the necessary skill to engrave a cage cup from a thick-walled beaker. Weidmann decided that there must have been some more practical approach to the problem of producing a blank, and his report suggests that the ancient "Nuppenglas" more nearly approached his idea of forming the diatretum blank than any other ancient glassware. Working along these lines he finally produced examples (Fig. 5).

In the patent papers issued to the Wurttembergischen Metallwaren Fabrik, Geislingen (Steige), Germany, July 28, 1939, Karl Weidmann described his method of manufacturing a diatretum blank (Fig. 8). In the patent

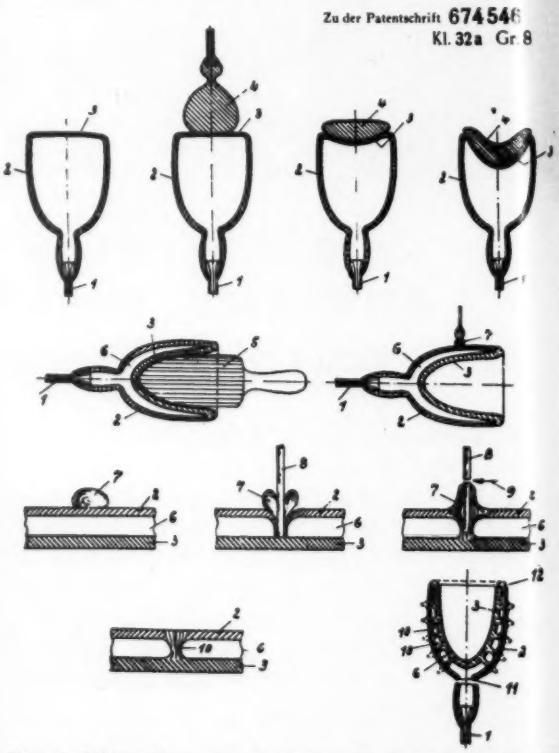


Fig. 8. Illustrations from the patent papers explaining Karl Weidmann's method for producing a diatreta blank. Starting upper left, drawings are numbered 1 to 11.

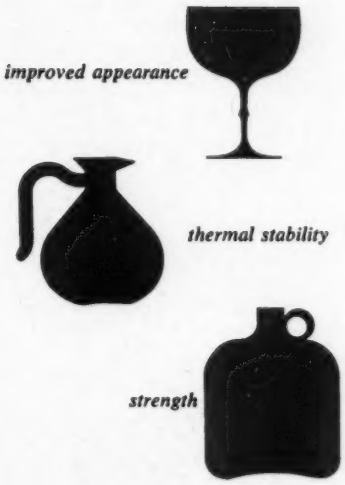
illustrations Fig. 1 shows the preliminary shape of the blow and the addition of a ball of plastic metal placed so that its weight begins to sag, or cave, in the upper portion of the blank. Fig. 4 shows this now-reinforced upper portion of the blank being pushed in with a tool to form the deep recess of the inner shell or cup. Figures 5 and 6 indicate the small blobs of hot, plastic glass being applied to the outer shell causing it to become soft at those points and allowing the worker to push through and partially withdraw from these soft spots

(*Continued on page* 446)

BORON: B

a vital constituent for glass

because B_2O_3 betters the batch



Boron is much in the news today.
New, and sometimes startling, uses for boron are being found in rapid succession.
But the virtues and functions of boron trioxide are well known to the makers of glass.
They've been the major users of borax since ancient days. First, to make incomparable glazes; later, to impart to glass a desirable resistance to thermal and mechanical shock. Down through the ages into present-day usage, the four valuable properties of B_2O_3 have benefited the glass industry by—(1) improved fluxing of the batch,
(2) decreased coefficient of expansion,
(3) increased resistance to corrosion,
(4) influence on the refractive index.

From our lengthy list, the greatest diversity of borates and boron products in the world, we offer the following group as satisfactory sources for B_2O_3 for the manufacture of all types of glass:

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- **BORAX,** $Na_2B_4O_7.10H_2O$
- **BORAX 5 MOL,** $Na_2B_4O_7.5H_2O$
- **BORIC ACID,** H_3BO_3
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(*Continued from page 442*)

the glass rod (Figs. 7 and 8). The outer shell is made smooth again by grinding off the protrusions left by the inserted rods, or these projections were cut into rosettes to conceal their utility, a trick the ancients also used.

The aperture between the inner and outer shell of the blank was filled with wax through the hole left by the removal of the blowpipe, lending the needed stability to withstand the pressures of the cutting operation.

In speaking of the engraving process, Mr. Weidmann said that it took more than one hour to make an 0.8 cm. bar (diameter 0.2 cm.) square by grinding it, and that it was impossible to polish it. He also stated that he used a transparent metal for the outer shell which enabled him to see where he was cutting; again, a practice the ancients seemed to follow.

After closely examining the Trier diatretum, found some 12 years after he patented his process, Weidmann concluded that this specimen corroborated his interpretation of the ancient's manufacturing process.

In more recent years Fred Carder of Corning, New York, produced several diatreta by the ancient cire perdue or, "lost wax" method, a predecessor to "investment casting." The article was first modelled in wax and afterwards covered with a ceramic paste. The wax model was melted out of the now-hardened paste leaving a mold which the glassmaker filled with finely pulverized glass (to be placed in a kiln overnight) or glass in a fluid state. To release the article from the mold, the shell of paste was broken away. In 1953 one piece of Mr. Carder's diatretum was sent to Germany, along with an extensive collection of American glass, where it was seen and admired by Karl Weidmann.

The noted Spanish-French glassman, Sala, has also produced modern diatreta but by what process is unknown to us. Mr. Sala prefers to keep his manufacturing methods a secret, a prerogative often exercised by artists.

The writer has drawn a few conclusions of his own concerning the possible method of manufacture used by the ancients. The precise spacing of the supporting struts leads us to believe that the inner body was formed by blowing a gather of glass into a mold, the sides of which were fitted with indentations to form the supports on the outer surface of the parison.

The blow, now studded with projections would then be lowered into a cup of glass of suitable size and shape and expanded by blowing until the supporting struts came into contact with the inner wall of the outer cup. Filling the space between the outer and inner shell with wax could be accomplished by cutting one or two preliminary holes in the outer shell and pouring the liquid wax between the walls of the blank. This method would seem practical to us today, a view shared by those glass technologists with whom we have discussed such a possibility. We should enjoy seeing it tried here in America.

• In order to clarify the announcement (page 390, July) of the merger of American Window Glass Company and Blue Ridge Glass Corporation, THE GLASS INDUSTRY wishes to point out that the latter is a wholly owned subsidiary of Saint-Gobain of Paris, France. The re-

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Long before the dawn of history, a miracle-laden, brown sand called monazite was formed in scattered places on our new-born planet. And locked within its glassy grains were the rich treasures of thorium and a group of unique metals, the rare earths.

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Lindsay's Cerium, Didymium (cerium-free) Salts, Neodymium and other rare earths are widely used to color and decolorize glass. They are available for prompt deliveries in quantities of a pound to a carload.

TRONA

LINDSAY CHEMICAL DIVISION

American Potash & Chemical Corporation

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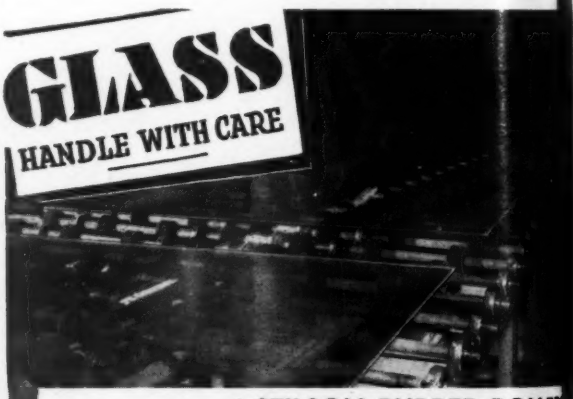
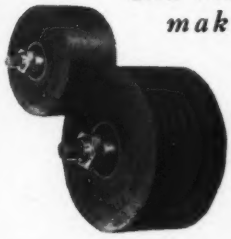
GLASS

HANDLE WITH CARE



and STILSON RUBBER ROLLERS

make it easy to comply



• Stilson Rubber Rollers provide the perfect scratch-free resilient contact surface that will not mark glass. Perfect conveyor roller for all shapes and sizes of glass . . . packaged or loose. These free wheeling rollers are available in a wide range of sizes and shapes.

WRITE FOR FOLDER

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Roseville, Michigan

sulting merger is now being operated as Blue Ridge Glass, a Division of American-Saint Gobain Corporation.

Inventions and Inventors

(*Continued from page* 434)

time-temperature cycles, and controlled atmospheric conditions thereby reducing considerably the overall time and labor generally involved in making such glasses.

The infrared transmitting glasses comprise arsenic sulphide glass, arsenic trisulphide glass, arsenic selenide or arsenic telluride glass, or glasses, composed of any desired combinations of arsenic, sulphur, selenium and tellurium.

There were 4 claims and the following references.

United States Patents

1,665,406, Danckwardt, Apr. 10, 1928; 1,898,039, Eckert, Feb. 21, 1933; 1,917,725, Lenander, July 11, 1933; 2,255,549, Kruh, Sept. 9,1941; 2,331,524, Wade, Oct. 12, 1943; 2,531,143, Malm et al., Nov. 21, 1950.

Glass and Wool Fiber

Apparatus for Forming Curled Glass Fibers. Patent No. 2,797,529. Filed March 19, 1952. Issued July 2, 1957. One sheet of drawings; none reproduced. Assigned to L-O-F Glass Fibers Company by John G. Mohr and Claude F. Harr.

This patent relates broadly to the processing of glass fibers or other heat softenable materials having characteristics similar to glass. More particularly, this invention refers to apparatus for producing a novel permanently curled glass fiber.

The invention provides a novel apparatus for the production of permanently curled fiber glass consisting of a rotating, grooved rod into one end of which a plurality of substantially straight glass fiber strands are fed in parallel relation. From the opposite end of the grooved rod curled composite fibers are removed, said rod rotating within a heated chamber to impart a permanent curl to the fiber strands carried thereon and being suitable for the formation of glass fibers with any desired degree of curl merely by varying the diameter or cross section.

Curled fibers produced in accordance with the above described invention possess a resiliency, compressibility and lightness in weight which renders them particularly suitable for fabrication into resilient mats for insulative and plastic laminate applications.

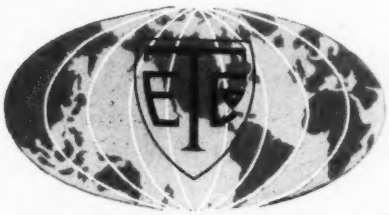
There were 2 claims and 14 references.

Apparatus For Gathering Glass Filaments. Patent No. 2,796,724. Filed August 16, 1951. Issued June 25, 1957. One sheet of drawings; none reproduced. Assigned to General Textile Mills, Inc. by Frank P. Jaros.

The invention relates to an apparatus for gathering glass filaments, and more particularly to an apparatus for gathering filaments at high speed while twisting them into glass yarn.

The glass filaments are formed by pulling them at a uniform speed from an orifice plate to which molten glass is fed. The pulling is done at a uniform rate to

In the glass center of the world



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attenuate the filaments uniformly, and they are collected into a sliver which is in turn gathered in a spinning pot, or the like, to form glass yarn.

In operating from pot to pot, the pot receiving the sliver is in the position of the tensioning apparatus and the pot to which the sliver is to be transferred is in an adjacent position. In order to maintain the proper position of pots during a continuous operation they may be mounted on a movable base and shifted to tensioning position just prior to cut-off.

The inner peripheral speed of the pot is higher than the speed of the sliver. This produces a twist in the glass sliver as it is being gathered. The greater the difference in the peripheral speed of the pot with respect to the speed of the sliver, the greater will be the twist. The twist is an important feature since it facilitates the unwinding and eliminates the hazards of handling parallel-positioned filaments.

There were eight claims and the following references cited for this patent:

United States Patents

1,822,018, Deile, Sept. 8, 1931; 2,412,403, Jackson et al., Dec. 10, 1946; 2,522,250, Bechtler, Sept. 12, 1950.

Foreign Patents

359,627, Great Britain, Oct. 29, 1931; 649,489, Germany, Aug. 12, 1937; 692,783, France, Mar. 26, 1930.

Metalized Glass Fibers and Products Thereof. Patent No. 2,797,469. Filed January 24, 1955. Issued July 2, 1957. One sheet of drawings; none reproduced. Assigned to the B. F. Goodrich Company by Henry Kahn.

This invention relates to coated glass fibers and pertains more particularly to flexible metalized glass fibers and products thereof.

In accordance with this invention glass fibers are produced in one of the well-known ways and are coated with a metal alloy comprising lead and at least one metal having a free energy of formation of the oxide* of the metal measured at 500°C. below—40 kilocalories per atom of oxygen selected from the group of metals consisting of sodium, potassium, magnesium, calcium, zinc, strontium, barium, aluminum, gallium, titanium, tin, chromium, manganese, cadmium, and iron. Of the above-named group of metals, the use in this invention of the metals zinc, aluminum, titanium, sodium and cadmium offers advantages in addition to those provided by the other metals of the group and, consequently, these five metals are preferred for use in this invention.

The glass fibers which may be used in this invention are any of the commercially available glass fiber materials although, as stated heretofore, this invention has particular application to metalized glass fibers formed of a low soda-ash glass.

The glass fibers to which the metal coating of this invention is applied should be of sufficiently small diameter to be of high strength and flexibility. While glass fibers up to about 0.01 inch may be used for some purposes, best results are obtained when very much finer glass fibers are used, glass fibers having a diameter of the order of 0.001 to 0.0001 inch being preferred.

* The term, "oxide of the metal," as used is intended to mean oxides of the metal in those instances where more than one oxide of the metal can be formed.

The metal coating of this invention may vary in dimension from the smallest thickness that can be deposited on the glass fiber up to as much as 0.01 inch or more in some instances, although a thickness of about 0.000005 to 0.0005 inch is now considered adequate.

The properties of the metalized glass fibers of this invention are further enhanced by providing a secondary coating over the metal coating, which is intended to facilitate relative motion between the metalized glass fiber surfaces. For example, the secondary coating may be composed of any oily or waxy material such as the high molecular weight hydrocarbons, alcohols, esters, organosiloxanes or the like, or such inorganic materials as metal sulfides or chlorides and the like, or a metal soap, or even a different metal.

There were 19 claims and the following references cited in this patent.

United States Patents

2,699,415, Nachtman, Jan. 11, 1955 and 2,720,076, Sachara, Oct. 11, 1955.

Sheet and Plate Glass

Plate Glass Polishing Apparatus. Patent No. 2,799,978. Filed April 2, 1956. Issued July 23, 1957. Three sheets of drawings; none reproduced. Assigned to Pittsburgh Plate Glass Company by Robert C. Perry and Fred W. Kocher.

The present invention avoids the necessity for manual connection and disconnection of the motor from its power source and its attendant danger by utilizing a circuit containing a novel electrical switch provided with one switch element fixed for vertical motion with a spindle drive motor and having electrical contacts attached electrically to the drive motor. The novel switch includes another switch element on a resilient support fixed to the support housing relative to which the polishing spindle moves vertically.

The latter switch element includes contacts connected to a potential source through an appropriate safety control circuit including special limit switches. The contacts of the other switch element are spring-urged away from the glass to make intimate electrical contact with the contacts of the first switch element before the polisher comes into contact with the glass. By virtue of such electrical circuitry, the drive motor circuit is brought into contact with the power circuit while the runners are spaced from the glass, thus enabling the drive motor to rotate the spindle and its suported polisher runners before the polishers contact the glass.

There were 11 claims and no references cited in this patent.

Tube and Cane Machines

Ribbon forming of hollow glass articles. Patent No. 2,807,121. Filed December 13, 1954. Issued September 24, 1957. Two sheets of drawings; none reproduced. Assigned to Owens-Illinois Glass Company by Joseph C. Hamilton.

The invention relates to a method and apparatus for forming hollow glass articles such as the light transmitting portions of a cathode ray tube or such other similar shaped articles.

(*Continued on page* 450)

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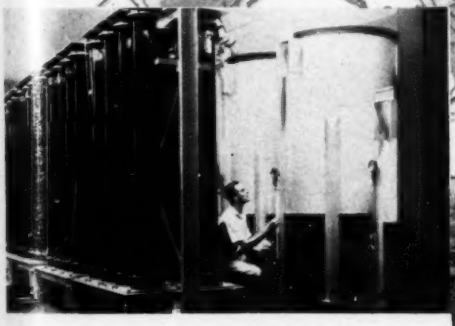

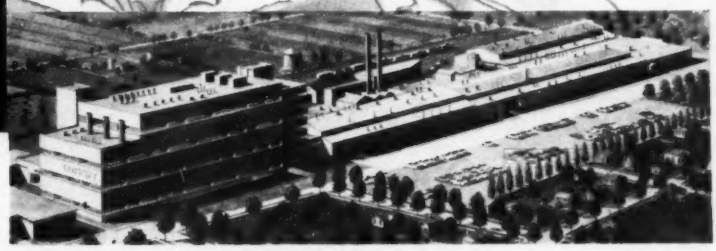

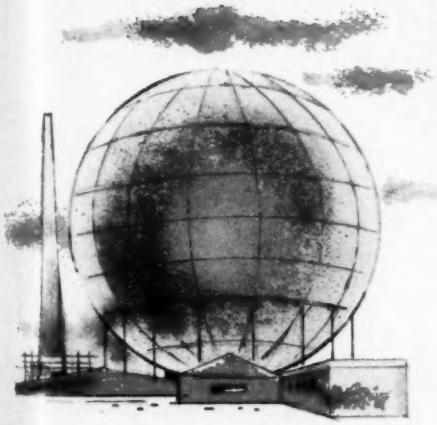

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Milestones in Glass Progress

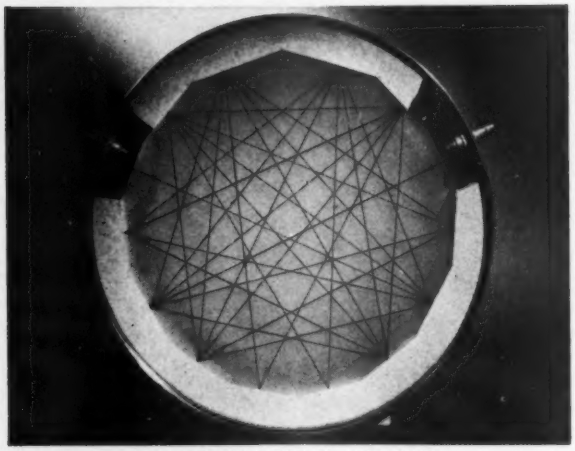

PHOTO COURTESY CORNING GLASS WORKS

1952 Developed for acoustic ultrasonic delay lines which convert radar into sound beams, fused silica is an ultra-pure glass with high melting range. Due to high structural purity, it is considered the most transparent glass available, with properties suitable for optical, chemical, electrical, radiation devices.

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Founded by a Glassmaker to Serve the Glass Industry

(*Continued from page* 448)

A method of forming hollow glass articles is given which first provides a continuous vertical ribbon flow of molten glass which is translated into a horizontal flow by synchronously moving a series of male shaping members at right angles to the vertical flow and into a position beneath and along one side of the ribbon. The top face and side portions of the ribbon are concurrently enveloped with the shaping members to finally shape the desired article from the ribbon.

The appearance of rings or circle-like marks which are highly detrimental to the light transmitting portions of the article are thus avoided.

There were 6 claims and the following references cited in this patent.

United States Patents

1,384,967, McSwain, July 19, 1921; 1,557,504, Vollmar, Oct. 13, 1925; 2,179,317, Barnard, Nov. 7, 1939; 2,301,892, Lewis, Nov. 10, 1942.

Foreign Patents

671,772, Great Britain, May 7, 1952.

Miscellaneous Processes

Methods and Means for Transferring Printed Indicia. Patent No. 2,796,374. Filed June 11, 1954. Issued June 18, 1957. One sheet of drawings; none reproduced. Assigned to Radio Corporation of America by Daniel J. Donahue.

This invention relates to methods and means for transferring printed indicia by the decalcomania process, and specifically, to a decalcomania transfer process producing transferred indicia having a high degree of dimensional fidelity with respect to the original printing plate. The methods and means of the invention are particularly well adapted to the manufacture of tricolor luminescent screens for all-electronic color television kinescopes.

A process is given for preparing a luminescent screen comprising printing luminescent indicia upon a backing member having good dimensional stability, attaching said indicia on said backing member to the surface of a substrate with a thin film of a liquid adhesive solid, such as a polyester and ethoxyline resin, polymerizing said resin film, and removing said backing member from said indicia.

In the use of a polymerizable resin adhesive, the solvent contained in the adhesive mixture is converted to a solid material during the polymerization of the resin. As a result, the problem of dimensional instability due to the removal of the solvent in the adhesive is completely eliminated.

According to one embodiment of the invention, a release agent such as a polyethylene wax, which does not require the application of water or other solvent, is used for the release of the backing member.

Preparation of decalcomania transfer is as follows:

A phosphor paste is prepared comprising 50 per cent of a blue-emitting phosphor, such as zinc sulphide with silver activator, 5 per cent nitrocellulose and 45 per cent isoamyl alcohol. The phosphor paste is then deposited

as a first set of dots, about .014" in diameter and about .042" from center to center, upon the coated surface of the backing member. Each phosphor dot contains about 2.5 mg. of phosphor/cm.^{2} of screen area. It is preferred to use a conventional silk screening process to deposit the phosphor dots, although other printing processes may be used.

When the first set of phosphor dots is dry, the second and then the third set of phosphor dots of the same size and spacing are deposited by the same method as the first set of dots. Each set of dots comprises a phosphor having a different emission color. The second set of phosphor dots, may comprise a green-emitting phosphor such as zinc silicate with manganese activator. The third set of phosphor dots, may comprise a red-emitting phosphor such as zinc selenide with copper activator. The second and third sets of phosphor dots are positioned upon the backing member with respect to the first set of dots so that triangular groups of three dots, all tangent to one another comprise one of each of the three different phosphors.

There were 12 claims and the following references cited in this patent: 2,426,462, Marksberry, Aug. 26, 1947; 2,476,570, Van Horn et al., July 19, 1949; 2,615,807, Umberger, Oct. 28, 1952; 2,681,293, Bayford et al., June 15, 1954; 2,716,081, Marks, Aug. 23, 1955; 2,716,082, Smith, Aug. 23, 1955; 2,734,013, Myers, Feb. 7, 1956; 2,757,112, Hoyt, July 31, 1956.

Acoustical Material. Patent No. 2,802,764. Filed October 8, 1952. Issued August 13, 1957. No drawings. Assigned to Owens-Corning Fiberglas Corporation by Games Slayter and Robert B. Taylor.

This invention relates generally to an improved acoustical material, and also to a method of manufacturing the material. More particularly, the invention concerns itself with an acoustical material adapted for use as a covering for walls and/or ceilings.

A film or membrane of thermoplastic material is firmly secured to the marginal edge portions of the mat of sound-absorbing material by the application of heat and pressure.

The membrane will shrink in response to the application of heat at the temperature required to seal the same to the fibrous mat. Thus the membrane is shrunk on the mat at the time it is heat sealed to the edges of the latter, and production of the product is greatly simplified.

The thin flexible film or membrane is stretched tightly over the exposed face of the sound-absorbing material, and is free to move relative to the sound-absorbing material under the influence of sound waves. The sound waves are transmitted to the fibrous material and are absorbed by the latter to such an extent that the noise-producing energy is substantially reduced. The film or membrane is preferably imperforate.

There were 6 claims and the following references cited in this patent.

United States Patents

2,029,441, Parkinson, Feb. 4, 1936; 2,031,900, Miller, Feb. 25, 1936; 2,045,312, Ross et al., June 23, 1936; 2,477,611, Irons, Aug. 2, 1949; 2,514,685, Virtue, July 11, 1950.

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Interpretation of Glass Stability

(*Continued from page* 431)

and the temperature gradient are known, the temperature at each hole can be determined. The temperature at the hottest cell containing crystals is the liquidus temperature. Microscopic observations permit measurement of crystal sizes after various heat treatments, yielding data on rate of crystal growth.

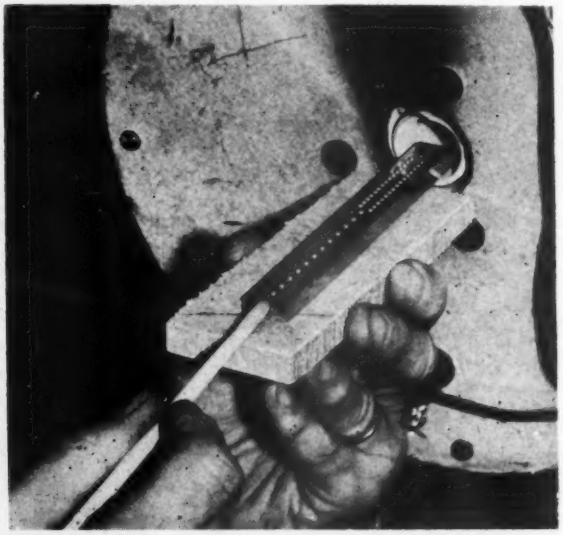

Fig. 3. Holder used in determining the liquidus temperature and rate of crystal growth of glasses at the National Bureau of Standards. Crushed glass, or a glass-crystal mixture, is loaded into the cells and the apparatus is heated in a furnace with a temperature gradient. The temperature at the hottest cell in which crystals remain is the liquidus temperature. By examining the crystals under a microscope their size can be determined, giving an indication of rate of growth.

A comparison of the experimental data with phase diagrams shows that compositions least likely to crystallize lie on flat liquidus surfaces or curves. The flat liquidus surface indicates the presence of a compound with a high degree of dissociation. The areas of relatively stable glasses may extend somewhat beyond the primary field of the dissociated compound. These adjacent areas may have relatively steep liquidus surfaces.

Just as stable glasses form from compositions on flat surfaces, compositions on steep surfaces, and not near a flat primary field, crystallize readily. In these crystallizing compositions the melt becomes supersaturated with respect to the primary phase when cooled. The observed

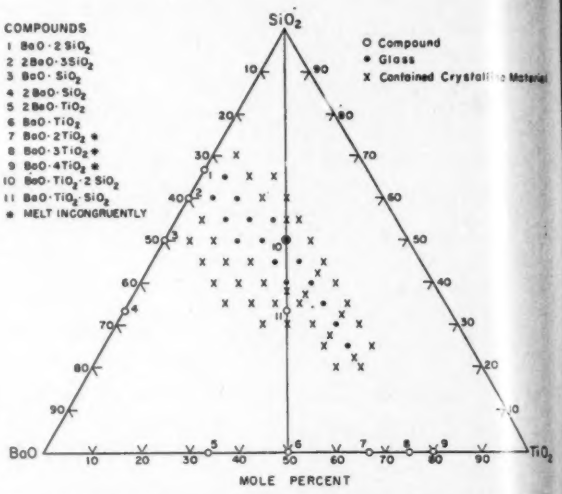

Fig. 4. Typical composition diagram used by the National Bureau of Standards in interpreting the structure of glasses. This diagram shows the glass-forming area of the barium titanium silicate system. $BaO\text{-}TiO_2.2SiO_2$ (10) is a highly dissociated compound at or above the liquidus temperature. The glass forming compositions which lie between this compound and $BaO.3TiO_2$ (8) are thought to be composed of chemical entities of the composition $BaO.3TiO_2$ dissolved in the highly dissociated $BaO.TiO_2.2SiO_2$. The other glasses are similarly considered to be a solution of chemical entities (such as 2 and 3) in the highly dissociated chemical entity (10).

ease and high rate of crystallization suggest that there are already present in these melts the same structural units that later form as crystals. Conversely, in the flat liquidus fields crystallization is difficult because the highly dissociated compounds would have to reassociate before they could form crystals. On this basis it seems probable that multi-component glasses are essentially solutions of chemical entities in dissociated chemical entities. This hypothesis does not necessarily contradict the random network theory often postulated to explain glass structure because the entities—both associated and dissociated—could still be randomly linked together in such a network.

REFERENCES

1 The shape of the liquidus surface as a criterion of stable glass formation, by Edgar H. Hamilton and Given W. Cleek, J. Research NBS (in press).

2 An improved apparatus for the determination of liquidus temperatures and rates of crystal growth in glasses, by O. H. Grauer and Edgar H. Hamilton, J. Research NBS 44, 495 (May 1950) RP 2096. New method studies crystallization in glasses. NBS Tech. News Bul. 34, 78 (June 1950).

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McLELLAN APPOINTED BY CORNING

George W. McLellan, formerly research physicist, has been appointed coordinator of technical information service in the division of public affairs by Corning Glass Works. He has been associated with the company's research and development division since 1940.

The new service will include presentation of lecture-demonstrations for technical audiences and editorial liaison concerning glass and ceramics.

NEW LIGHT BULB DESIGN

The Westinghouse lamp division has announced the first change in the styling and design of standard light bulbs in more than 25 years. The new design is somewhat cylindrical in shape; the interior surface of the bulb has a special electrostatic silica coating.

New design of light bulb, left, and standard bulb, first change in styling and design in more than 25 years. New lamp has special coating on inner surface.

The bulb has a greater surface area than the ordinary type of the same diameter. There is better light distribution and substantially less surface brightness, according to F. M. Sloan, Westinghouse vice president, because the larger surface area permits more silica coating on the inside.

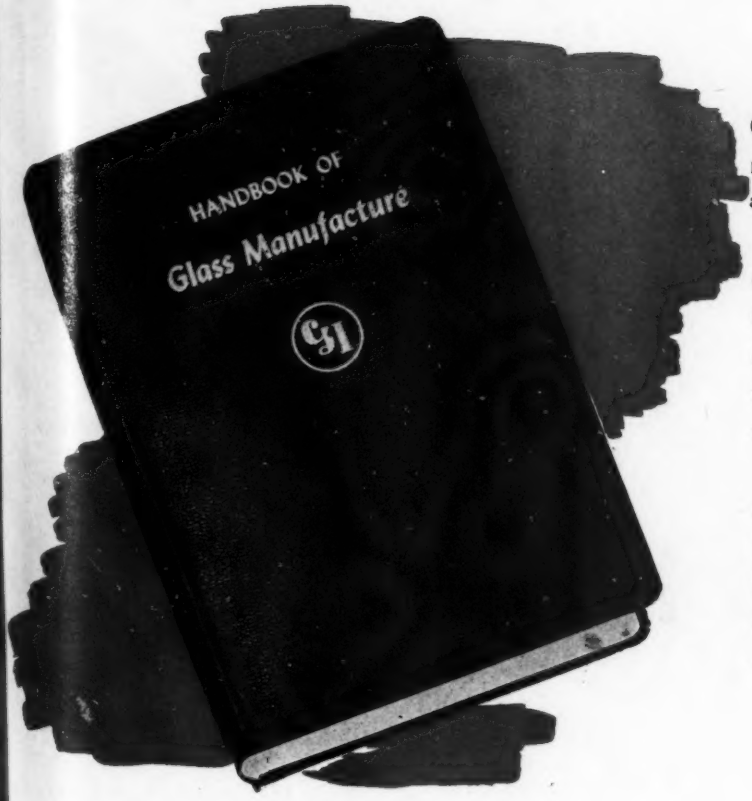
ERRATA

On page 354 of the June issue there is a paragraph announcing the appointment of W. H. Cook as manager of the Corrugated Container Division of Anchor Hocking Glass Corporation in Lancaster, Ohio. The headline erroneously states that W. B. Snell, Jr. received this appointment.

Mr. Snell is vice president of manufacturing of Anchor Hocking Glass Corporation, and it was he who made the original announcement.

Again available

Handbook of Glass Manufacture



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